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ADVANCED METALLIC AIR VEHICLE STRUCTURE PROGRAM

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SIXTH INTERIM REPORT

GENERAL DYNAMICS
FORT WORTH DIVISION

AUGUST 1976

TECHNICAL REPORT AFFDL-TR-76-74

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This technical report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Wing Carrythrough Structure (WCTS) completed the first service life of fatigue testing on 30 March 1976. Structural problems were limited and consisted primarily of failed, cracked or loosened fasteners. During the down-time for the scheduled major inspection at one-life, design changes were incorporated in the WCTS to resolve the fastener problems. (over)

Design studies and related stress analyses were accomplished in support of fatigue testing problems. Analysis of data from full scale fatigue testing was accomplished, including comparison to predicted data. Additional stress analyses were accomplished where required to properly assess test data results.

Static, fatigue and fracture analyses for the updated baseline data received from Rockwell International in late 1975 were essentially completed and documentation of these analyses is currently in work.

The outstanding phases (crack growth tests and 10 Nickel weldment tests) of the Credible Option Test Program were completed.

FOREWORD

This report covers the period 22 October 1975 through 18 April 1976. The efforts reported herein were sponsored by the Air Force Flight Dynamics Laboratory (AFFDL) under joint management and technical direction of AFFDL and the Air Force Materials Laboratory (AFML), Wright-Patterson Air Force Base, Ohio.

This work was performed under Contract F33615-73-C-3001 "Advanced Metallic Air Vehicle Structure" (AMAVS) as a part of the Advanced Metallic Structures, Advanced Development Programs (AMS ADP), Program Element 63211F, Project Number 486U0104. J. S. Ford II, Lt. Col., USAF (AFFDL/FBA), is the ADP Manager, with Mr. N. G. Tupper (AFML) serving as Deputy ADP Manager. Mr. C. R. Waitz (AFFDL/FBA) is the Project Engineer for the AMAVS Program.

Earlier documentation of this program is contained in the following AFFDL-TR-XX-Y reports:

Phase Reports			Interim Reports	
Ph I	Prel. Design	- 73-40	1st	73-1
Ph II	Detail Design	- 74-17	2nd	73-77
Ph III	Fabrication	-	3rd	74-98
			4th	75-40
			5th	76-8

Principal General Dynamics contributors to this report were:

R. C. Bissell - Program Manager
R. E. Miller - Stress Analysis
K. D. Mabry - Structural Design
R. S. Chambers - Stress Analysis

This work was performed during the period 22 October 1975 through 18 April 1976. It was submitted by the authors in May 1976.

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SECTION 1

INTRODUCTION

This interim report summarizes the accomplishments of the Advanced Metallic Air Vehicle Structure (AMAVS) Program from 22 October 1975 to 18 April 1976. This work is part of the Air Force's Advanced Metallic Structures, Advanced Development Program. It was performed under contract to the Air Force Flight Dynamics Laboratory (AFFDL) by the Fort Worth Division of General Dynamics.

The six months covered by this report include primarily the accomplishment of the first fatigue service life of the Full Scale Test Program being conducted by the Structural Test Facility at WPAFB with support being provided by General Dynamics. Also included are the additional material testing funded under the "Credible Option" task, contractual drawing requirement activities, and the analyses related to updated baseline loads/spectrum data. Activities leading to start of the fatigue test program are reported in the Fifth Interim Report, AFFDL-TR-76-8, dated February 1976, and included the following significant items:

1. Final stages of manufacture of the wing carrythrough structure (WCTS).

2. Mating of the WCTS to the upper test structure.

3. Completion of the hardware and software elements of the test set-up leading to an operational test system.

4. Baseline inspection of the WCTS.

5. Strain surveys to verify load distributions.

6. Incorporation of updated loads/spectrum data from Rockwell International (RI) to make the AMAVS test program current with latest available baseline data.

7. Final system check-out runs.

A contract change to incorporate updated loads/spectrum data from RI was received in July, 1975. As reported in AFFDL-TR-76-8,

initial effort with the updated data was directed towards generating revised ram loads and fatigue spectrum for use in the Full Scale Test Program. With receipt of the final data from RI in November, 1975, final fatigue and fracture analyses were initiated and essentially completed, except for documentation, during this reporting period. In addition Math Model analysis using the limited static loads information available was accomplished.

Material testing, comprising mechanical property testing on EB/GTA welded 10 Nickel steel and crack growth testing on both 6Al-4V titanium and 10 Nickel steel, was completed. With the exception of final analysis/documentation and completion of tests being conducted at WPAFB, this testing completes the "Credible Option" test task.

SECTION 2

TECHNICAL DISCIPLINES PROGRESS

The progress made by the technical groups during the initial stages of Phase IV, Test and Evaluation, is reported in this section.

2.1 ENGINEERING

The engineering functions progress for the period 22 October 1975 to 18 April 1976 is detailed below.

2.1.1 Structural Design

Design activities during this reporting period were devoted primarily to supporting the Full Scale Test Program at Wright-Patterson Air Force Base (WPAFB). Design changes were implemented to correct structural deficiencies of the wing carrythrough structure (WCTS) experienced during the first service life of fatigue testing. Update of the production drawings for the "No-Box-Box" (NBB) configuration was completed and some progress was made on the "Fail Safe Integral Lug" (FSIL) configuration drawings.

2.1.1.1 Full Scale Test Support

The design group provided technical assistance to the Fatigue Test Program at WPAFB on an "as required" basis. Design and coordination of required repair tasks were accomplished. On-site technical support was provided during the repair activity and major inspections.

Special wrenching mechanisms were designed to realign the pivot pins and lug bushings which rotated during the early stage of testing. Retaining systems were also designed to prevent recurrence of the rotation problem (See Figures 2.1.1-1 and 2.1.1-2). Repair procedures, hardware, tools, and supplies were planned and coordinated for replacement of broken fasteners, restoration of the pivot system, and retention of bolts experiencing repeated loosening.

On-site technical support was provided during the pivot system restoration, fastener replacement following Flight 640, Taper-lok hole rework and bolt reinstallation, and the first two Category III inspections. In addition, support was provided during the Category IV inspection and structural modification program following completion of one fatigue life.

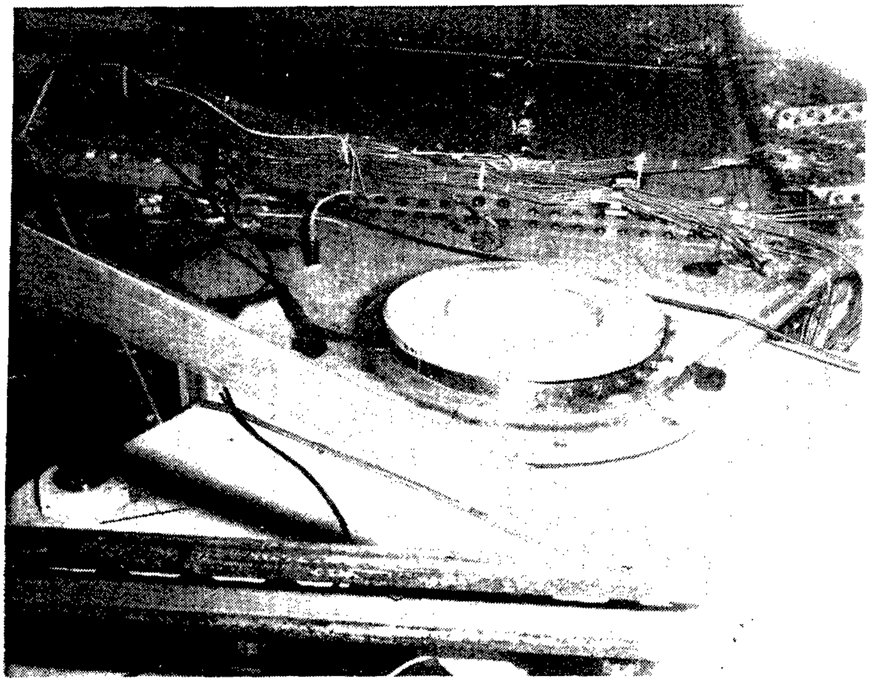

FIGURE 2.1.1-1

RETENTION OF UPPER BUSHING TO PIVOT PIN

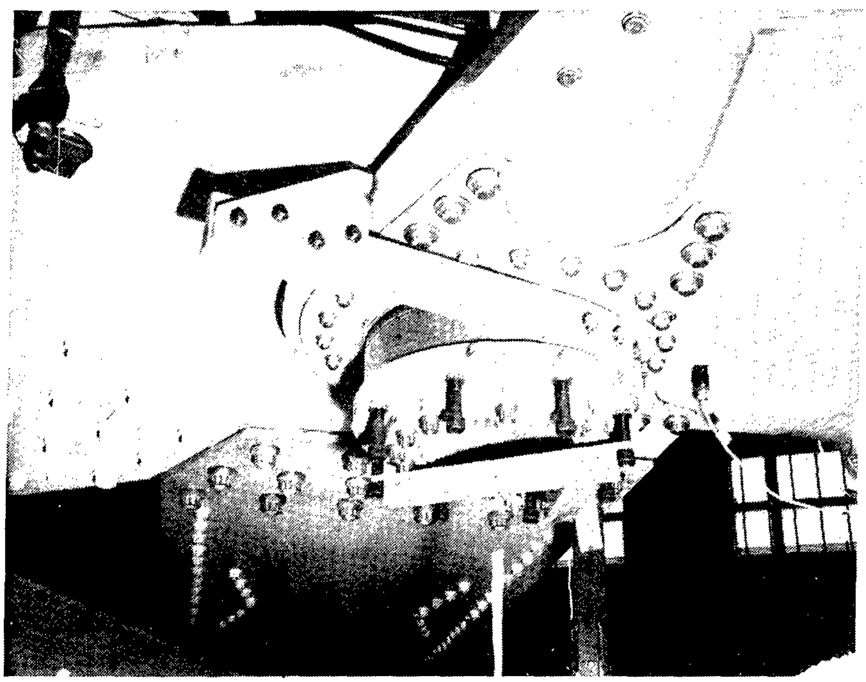

FIGURE 2.1.1-2

RETENTION OF LOWER BUSHING TO WCTS LOWER LUG

Hole number drawings were prepared for the WCTS to provide a common base for hole identification during the test program. These drawings are included as figures in Section 2.2.1 of this report.

2.1.1.2 Design Changes

Fastener revisions to the WCTS assembly were required to improve structural reliability since repeated loosening and failures of fasteners occurred during the first service life of testing. A reassesment of the fastener locking features and structural capability of involved joints verified the necessity for fastener revision.

Short threaded fasteners, attaching the access covers of the Y_F 992 bulkhead, were replaced with longer threaded bolts (NAS 674) to insure thread engagement with the locking feature of the nut-plates.

Straight shank fasteners (22 per side), attaching the bonded panel to the Y_F 992 bulkhead in the upper outboard corner, were increased in size from 3/8" to 7/16" diameter. A new 7/16" bolt was also added to this area.

Shear bolts (2 per side); attaching the X_F 84 rib to the Y_F 932 bulkhead and common to the bonded panel, upper gusset, and bulkhead support fitting; were increased in size from 3/8" to 1/2" and 7/16" diameter.

Hi-Lok fasteners, attaching the outboard bonded panel of the Y_F 932 bulkhead to the X_F 39 rib, were replaced with shear bolts of the same diameter.

Documentation and authorization of these changes were accomplished on Engineering Change Notices (ECN). ECNs were required on Drawings X7224001, X7224060, X7224120, and X7224130 to identify these fastener revisions.

2.1.1.3 Engineering Drawing Update

The NBB production drawings were updated to the configuration of the WCTS as it was fabricated by the incorporation of all outstanding ECNs. A total of 211 ECNs was outstanding on 92 drawings at the time the WCTS was completed. During this reporting period, the final 89 ECNs, representing 38 drawings, were incorporated. Final completion of the required 27 Air Force Parts Lists was also accomplished.

The FSIL configuration is described by 101 drawings of which 76 were completed at the time the NBB configuration was selected for fabrication. The top assembly drawing (X7223701), consisting of four sheets, was prepared to a 90% completion level. No work was accomplished on the 24 remaining drawings.

2.1.2 Structural Analysis

2.1.2.1 General

During the reporting period, activities of Structural Analyses personnel included the following:

1. Assembled updated panel point loads data and ran NBB 5 series UGO finite element models for all necessary unit, fatigue, and static conditions.

2. Consolidated information stored on tape from UGO model runs and produced a single tape with data for use in fatigue analysis.

3. Predicted stresses at existing fatigue control points for updated analytic spectrum where stresses were not directly available from UGO models. Compared stresses with test strain gage data.

4. Reviewed and analyzed data gathered during full scale testing and performed related additional stress analysis. Selected location for added gages.

5. Provided stress analysis support for design of tools and devices to reposition and retain pivot pins, spacers, and bushings after considerable rotational displacement occurred during fatigue testing.

2.1.2.2 Design Loads

The loads and spectrum information for fatigue testing and analysis remained essentially as reported in AFFDL-TR-76-8, the Fifth Interim Report. However, a limited number of static load conditions from Rockwell International (RI) were provided by AFFDL for use in evaluating static strength. These static conditions are preliminary and do not form a complete set of critical static design loads.

They were developed by superposition of some of the basic conditions supplied for fatigue analysis. The superposition factors were determined so as to give limit wing bending moments equal to those from RI for the basic condition combinations specified. The ultimate static conditions are as follows:

9010. Maximum Wing Bending, 2g, flaps down, post takeoff, 15^{o} sweep

1.726X(031210 + 032210)

9020. 25^{o} sweep

1.759X(021440 + 022440)

9030. Maximum Torque, .86M, 67.5^{o} sweep

2.0187 X 051750 + 4.0374 X 052750

9040. Maximum Down Bending, 2g, taxi

3.00 X 010100

The four digit condition numbers were assigned by G/D for in house use.

2.1.2.3 Finite Element Stress Analysis

The overall box stress analysis was carried out using General Dynamics Procedure UGO. Prior to the computer runs, the UGO program was modified as follows:

1. The output format and internal calculations were altered so that principal stresses and effective stresses are available for static, fatigue, and fracture analysis.

2. The internal calculations were altered so that for one option quadrilateral membrane element stresses are determined by an area weighted average of the stresses for the four component triangles. Such averaging yields better results than a direct stress average when the triangles do not have approximately equal areas. In addition, results are identical to those of General Dynamics Procedure TN1 which was used for earlier AMAVS analysis allowing for more direct stress comparisons.

As discussed in AFFDL-TR-76-8, General Dynamics Procedure CM7 was developed to convert modified RI information to panel point loads for the UGO model. The procedure was applied for all updated basic and modified basic conditions.

The panel point loads data was merged with the model geometry and boundary condition data for the NBB 5 Model which was based on the final AMAVS design drawings. Seven separate models were run to cover all known fatigue and static conditions derived from the updated basic conditions. Each UGO run can handle a maximum of ten separate loading conditions; however, these conditions can be superposed internally to form a large number of final conditions. Thus, by grouping the basic conditions appropriately, results for several fatigue and static conditions were obtained from a single UGO run. Duplicate conditions were eliminated for efficiency. (See Table 2.1.2-I for duplicates). In addition to the fatigue and static conditions, unit conditions were also run so that some manual superposition could be done at a later time if new conditions were to develop. Data on the make up of load sets and conditions for each UGO run is shown in Tables 2.1.2-II and 2.1.2-III. Computer resource unit usage information and other pertinent data are shown in Table 2.1.2-IV.

2.1.2.4 Preparation of Finite Element Data for Fatigue Analysis

Although printed stress and deflection data was obtained for all of the models of Section 2.1.2.3, the large bulk of printed material precluded efficient use of the printed material except for spot checking. Consequently, the UGO option to obtain stress and geometry data on magnetic tape for each run was utilized. The seven UGO tapes thus obtained were used to make two intermediate tapes. A program was written to extract the stress and geometry data from these two tapes and to produce a single tape. This single tape was then available for direct data input to fatigue analysis programs. In addition, a program was written to allow principal and effective stresses for any element or set of elements to be listed in descending effective stress order to further aid in reviewing the large amount of data generated in the computer runs. The ordered effective stress program utilizes the single fatigue data tape as input.

2.1.2.5 Additional Stress Data for Fatigue Analysis

Although the UGO finite element model adequately predicted many stresses in the WCTS, the grid size was still too large or the manner of concentrated load introduction too approximate to allow accurate stress predictions at some control points. Consequently, stresses

TABLE 2.1.2-I

CROSS REFERENCE LISTING OF DUPLICATE FATIGUE CONDITIONS

DUPLICATE FATIGUE COND.	UGO RUN FATIGUE COND.	FC	UGO	FC	UGO
509	508	635	136	678	164
11	10	640	141	179	165
511	510	642	142	679	165
517	516	643	143	180	129
521	21	651	152	680	666
522	22	653	153	181	142
27	526	660	659	681	142
535	36	163	150	182	143
537	37	663	650	682	143
538	38	664	164	183	150
542	43	665	165	184	153
547	48	166	129	684	153
552	53	167	142	185	156
554	54	667	142	685	656
555	55	168	143	186	159
559	60	668	143	686	659
564	65	169	150	187	161
66	23	669	650	687	661
566	523	170	153		
67	24	670	153		
567	524	171	156		
68	25	671	656		
568	525	172	159		
69	26	672	659		
569	526	173	161		
70	526	673	661		
570	527	174	161		
571	71	674	661		
572	72	175	156		
589	588	675	656		
606	106	176	159		
607	107	676	659		
625	125	177	150		
626	126	677	650		
630	131	178	164		

TABLE 2.1.2-II

LOAD SETS FOR UGO MODELS

LOAD SET/MODEL	NBB 5-5	NBB 5-6	NBB 5-7	NBB 5-8	NBB 5-9	NBB 5-10	NBB 5-11
1	60100	51440	91870	51750	111620+1057.55	111210	51750
2	66100	52440	92870	52750	81430+1057.25	113210	52750
3	10100	53440	91770+1072.675	53755	81430	112210	53755
4	16100	51440-1072.25	31440+1072.25	71760	82430	120100	71760
5	31210	91770-1072.675	31440	73765	101440	126100	73765
6	32210	91770	32440	72760	102440	17100	72760
7	17100	92770	21440	111620+1044.55	81530	111310	111620+1044.55
8	31210-1345.15	111780	22440	111620	82530	41430-1345.25	111620
9	41430	112780	51750-1057.675	112620	81430+1248.25	111210-1248.15	112620
10	42430	41430-1057.25	71760+1044.675	113620	111210+1248.15	81430-1248.25	113620

NOTES: 1) NBB 5-11 was to have been obtained as part of NBB5-8, but a system problem aborted NBB 5-8 after 65 conditions so NBB 5-11 was run to complete the analysis.

TABLE 2.1.2-III

LOAD CONDITIONS FOR UGO MODEL

NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.
5/ 1	1	5/39	520	6/21	38	7/17	58	8/20	582	8/58	101	10/ 1	144
2	501	40	(804)	22	39	18	558	21	83	59	601	2	644
3	2	41	(805)	23	539	19	59	22	583	8/60	102	3	145
4	502	42	21	24	40	20	60	23	84	9/ 1	125	4	645
5	3	43	23	25	540	21	560	24	584	2	126	5	146
6	503	44	523	26	41	22	(812)	25	85	3	(821)	6	646
7	4	45	24	27	541	23	61	26	585	4	127	7	147
8	504	46	524	28	42	24	561	27	86	5	627	8	647
9	5	47	25	29	43	25	62	28	586	6	128	9	148
10	505	48	525	30	543	26	562	29	87	7	628	10	648
11	6	49	26	31	(809)	27	63	30	587	8	129	11	149
12	506	50	526	32	44	28	563	31	88	9	629	12	649
13	7	51	527	33	544	29	64	32	588	10	130	13	150
14	507	52	(806)	34	45	30	65	33	89	11	131	14	650
15	8	53	(908)	35	545	31	565	34	90	12	631	15	151
16	508	54	(916)	36	46	32	(813)	35	590	13	666	16	152
17	9	55	(9010)	37	546	33	72	36	91	14	132	17	652
18	(801)	5/56	(9040)	38	47	34	106	37	591	15	632	18	683
19	10	6/ 1	28	39	48	7/35	(9020)	38	92	16	133	19	(824)
20	510	2	528	40	548	8/ 1	73	39	592	17	633	20	(825)
21	12	3	29	41	(810)	2	573	40	93	18	134	21	154
22	512	4	529	42	71	3	74	41	593	19	634	22	654
23	13	5	30	7/ 1	49	4	574	42	94	20	135	23	155
24	513	6	530	2	549	5	75	43	594	21	136	24	655
25	14	7	31	3	50	6	575	44	95	22	636	25	156
26	514	8	531	4	550	7	76	45	595	23	(822)	26	656
27	15	9	32	5	51	8	576	46	(814)	24	137	27	157
28	515	10	532	6	551	9	77	47	(815)	25	637	28	657
29	16	11	33	7	52	10	577	48	96	26	138	29	158
30	516	12	533	8	53	11	78	49	596	27	638	30	658
31	17	13	34	9	553	12	578	50	97	28	139	31	159
32	(802)	14	534	10	(811)	13	79	51	597	29	639	32	659
33	(803)	15	35	11	54	14	579	52	98	30	140	33	160
34	18	16	36	12	55	15	80	53	598	31	141	34	161
35	518	17	536	13	56	16	580	54	99	32	641	35	661
36	19	18	(807)	14	556	17	81	55	599	33	823	36	162
37	519	19	(808)	15	57	18	581	56	100	34	142	37	662
5/38	20	6/20	37	7/16	557	8/19	82	8/57	600	9/35	143	10/38	(826)

TABLE 2.1.2-III (Cont'd)

LOAD CONDITIONS FOR UGO MODEL

NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/#SOL.	COND. NO.	NBB5-X/SOL.	COND. NO.
10/39	153	11/ 8	(816)	11/19	611	11/30	116	11/40	121
40	22	9	(817)	20	113	31	616	41	621
41	164	10	(818)	21	613	32	117	42	122
10/42	165	11	107	22	114	33	617	43	622
11/ 1	602	12	108	23	614	34	118	44	123
2	103	13	608	24	(819)	35	618	45	623
3	603	14	109	25	(820)	36	119	46	124
4	104	15	609	26	115	37	619	47	624
5	604	16	110	27	615	38	120	48	(827)
6	105	17	610	28	215	11/39	620	11/49	(9030)
11/ 7	605	11/18	111	11/29	715				

NOTES: 1) Condition numbers not in ( ) are Fatigue Conditions.

2) Four digit Cond. Numbers indicate Static Ult. Conditions.

TABLE 2.1.2-IV

NBB LOADS UPDATE COMPUTER DATA

Model Designation (3)	Computer Resource Units (1)	Number of Load Conditions
NBB 5-5	1.073	56
NBB 5-6	.860	42
NBB 5-7	.801	35
NBB 5-8 (2)	1.127	65
NBB 5-9	.813	35
NBB 5-10	.915	42
NBB 5-11	.976	49

1) Essentially time charged in hours.

2) Five conditions of 5-8 overlap 5-11

3) Model has 2107 bar and membrane elements with 932 nodes.

were estimated at selected points for the updated analytic fatigue spectrum using distributions obtained from fine grid models (General Dynamics TLO, linear strain elements) run during the design phase and from other supplementary analyses. In addition, strain gage data for gages located near control points was tabulated so that test results could be considered in the fatigue analysis where necessary. The locations of the control points and strain gage locations are shown in Sections 2.1.3.1 and 2.1.2.4, respectively, of AFFDL-TR-76-8.

For control point 1, the pertinent test stresses obtained from flight number 1 are shown in Table 2.1.2-V.

For control point 2, TLO results for 15^{o} and 67.5^{o} degree sweep angles were used to obtain estimated stress distributions across the net section. For sweep angles between 15 and 67.5^{o} and positive wing bending, the load vector obtained from CM 7 runs was resolved into components in the forward and aft sweep resultant directions used for the two TLO analyses. The stress distributions based on these components were then superposed. For pivot pin loads in a direction forward of the TLO forward sweep resultant direction, all load was assumed in the TLO forward sweep resultant direction. Similarly, for pin loads in a direction aft of the aft sweep resultant direction, all load was assumed in the TLO aft sweep resultant direction. For negative wing bending, approximate values were obtained from the UGO runs. These latter negative values were small and the approximation was considered acceptable. The calculations were carried out using the HP9830 calculator. Results for typical conditions as well as test stresses are shown in Figures 2.1.2-1 and 2.1.2-2.

For control point 3, the test stresses are shown in Table 2.1.2-VI.

The test stresses for control point 4 are shown in Table 2.1.2-VII.

Test stresses in the vicinity of control point 5 are shown in Table 2.1.2-VIII.

For control point 6, stresses were estimated using upper longeron basic loads data from NA-75-346 combined to form the fatigue condition loads along with cross section areas developed from AMAVS drawings. The results are shown in Table 2.1.2-IX. No directly applicable strain gage data was recorded.

TABLE 2.1.2-V

STRAIN GAGE DATA - CONTROL POINT 1

GAGE/FATIGUE COND.	12	14	16	18	518	518	20	520	34	537	38	39
4003 SL	4899	4536	4899	32571	4899	4445	24042	11976	22137	15242	6169	13699

GAGE/COND.	539	539	549	51	560	61	561	63	563	88	588
4003 SL	-1905	-2361	-4269	8173	10535	29426	4450	23613	9536	16620	6902

GAGE/COND.	117	617	119	619	122	127	637	148	150	166	169
4003 SL	14985	7810	13350	9354	12800	23795	0	26247	19436	18346	19435

NOTES:
1) Stresses in PSI
2) Approx. Zero Shift Correction Included.
3) Flight 1

Figure 2.1.2-1

WCTS LOWER PIVOT LUG
TYPICAL MEASURED AND PREDICTED STRESSES

NOTES:

1. ——— F/C 39 Predicted σ Max, Λ = 67.5°
2. — — F/C 117 Predicted σ Max, Λ = 55°
3. □ F/C 39 Test σ Axial, No μ Corr.
4. ○ F/C 117 Test σ Axial, No μ Corr.
5. Gages 32° from Spanwise Axis
6. Model Stresses 45° from Spanwise Axis
7. See Fig. 2.1.2-1 of AFFDL-TR-76-8 For Gage Locations and Orientations

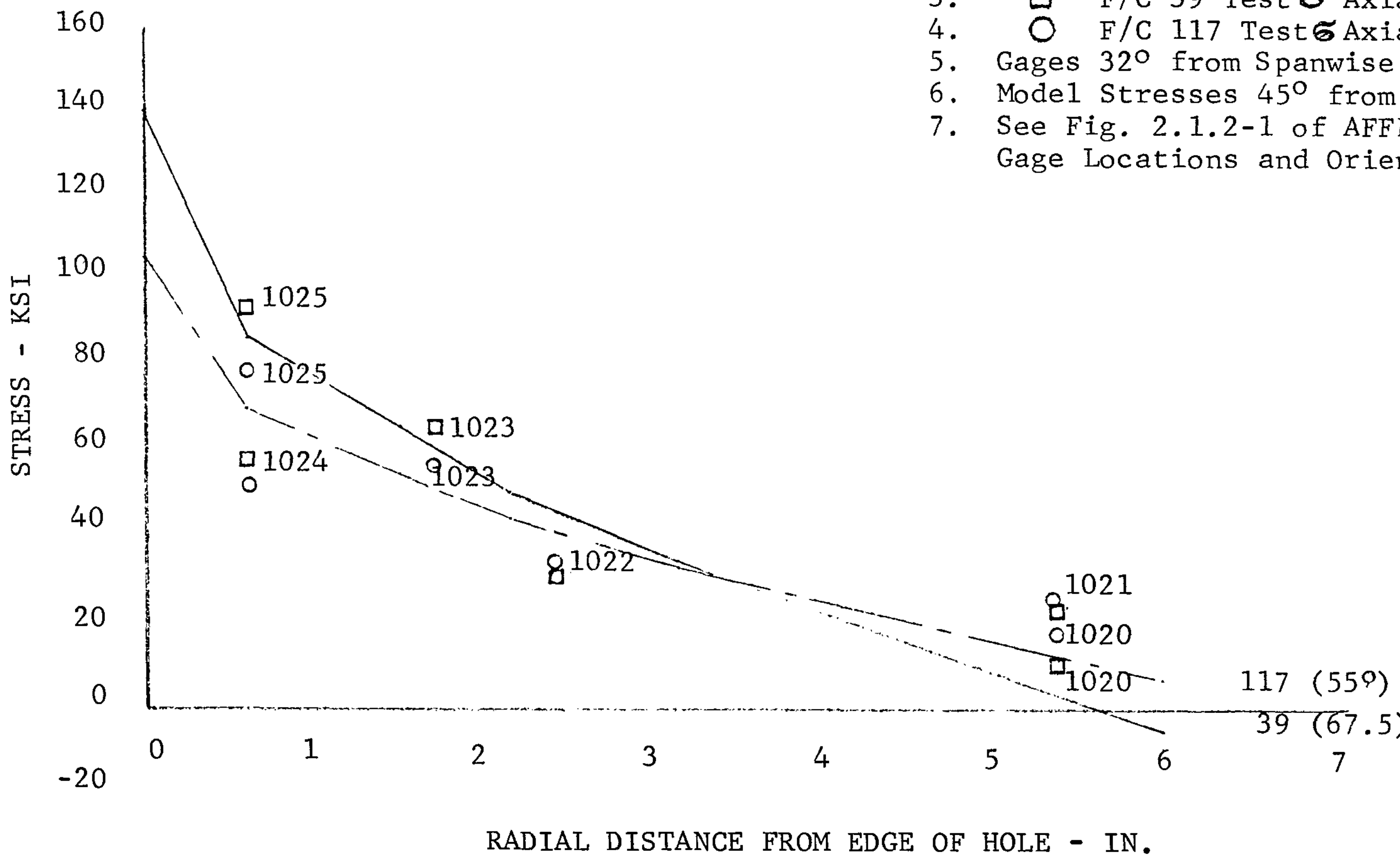

Figure 2.1.2-2

WCTS LOWER PIVOT LUG
TYPICAL MEASURED AND PREDICTED STRESSES

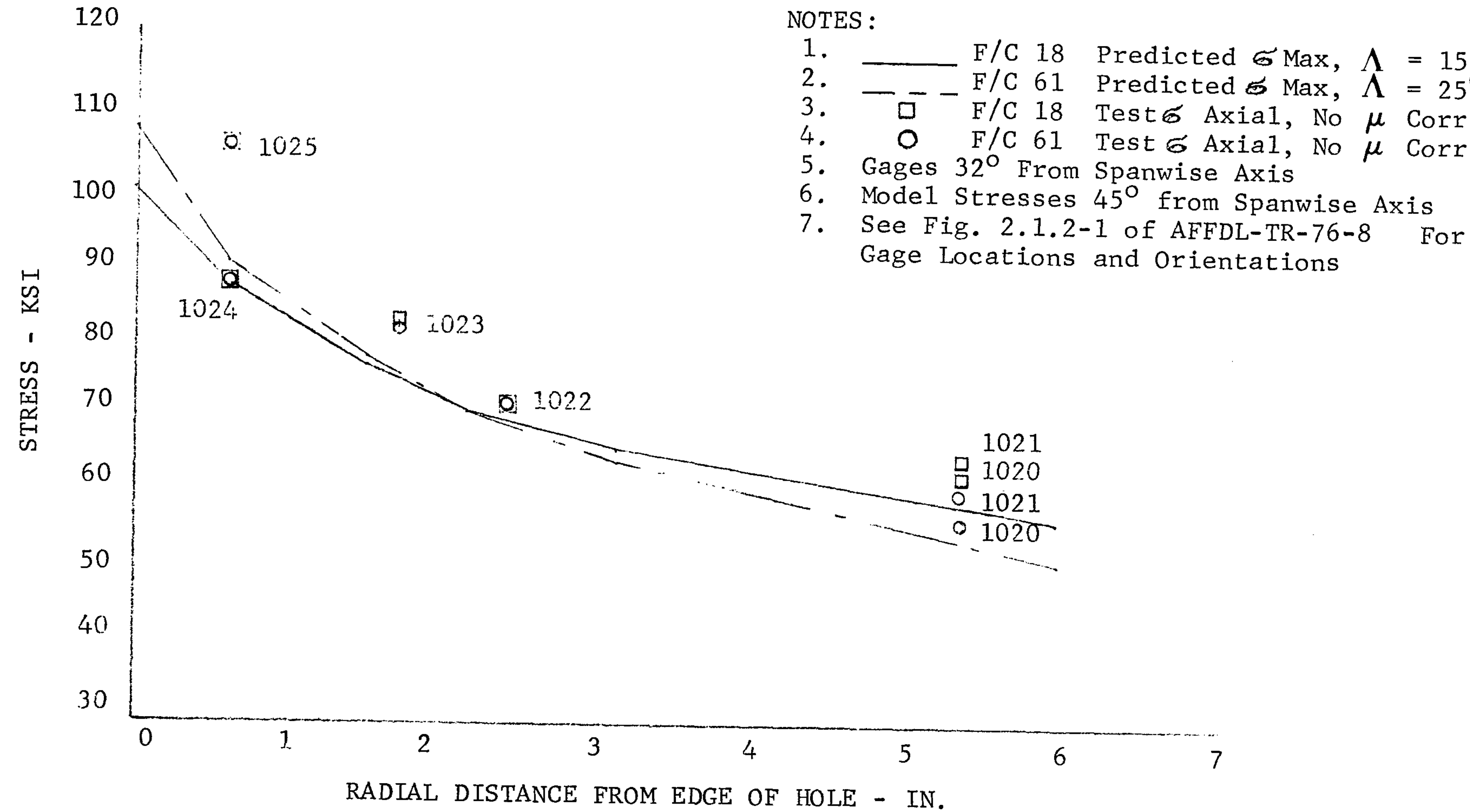

TABLE 2.1.2-VI

SEE NOTES ON TABLE 2.1.2-V

STRAIN GAGE DATA - CONTROL POINT 3 VICINITY

GAGE/FATIGUE COND.	12	14	16	18	518	518	20	520	34	537	38	39
1006 SL	-5910	-5133	-2333	69362	14929	14151	52565	28615	52565	35614	20995	54121
1007 SL	-5501	-4872	-2358	68842	19018	18703	53281	31749	56582	39135	32063	81416
1004 SL	-7139	-5897	-1862	43763	12725	12881	39729	27469	39263	33211	15830	35694
1005 SL	-6837	-5750	-2331	40869	19113	20202	36053	27662	37452	31391	27972	44755
1002 SL	-8054	-6949	-3001	62058	15316	14844	49427	29214	49901	36004	23056	56059
1003 SL	-10647	-9394	-5324	72957	20352	20217	58144	35106	59554	43098	32754	73345
1008 SL	-4202	-3736	-1400	69270	18213	17919	54226	31943	56251	39111	28359	71054

GAGE/FATIGUE COND.	539	539	549	51	560	61	561	63	563	88	588
1006 SL	-4044	-4821	-8554	32037	24106	70606	10264	56298	21928	60342	22239
1007 SL	-14774	-14288	-17428	51186	27320	74267	12875	59822	24965	82431	31716
1004 SL	-1707	-3880	-7449	22968	22192	42211	8845	39107	20484	37555	17381
1005 SL	-17404	-19250	-22044	33842	23907	40828	11954	36015	22199	43623	25614
1002 SL	-7737	-8834	-13724	35335	24923	62941	10569	52214	22557	59628	24135
1003 SL	-18650	-18355	-22904	49575	31063	75774	14748	63067	28553	75931	33416
1008 SL	-7947	-8717	-11675	43741	26929	73628	12142	59463	24595	74095	28486

GAGE/FATIGUE COND.	117	617	119	619	122	127	637	148	150	166	169
1006 SL	47589	23172	42146	28304	39968	57076	3421	59253	45256	44012	45257
1007 SL	64061	30774	56995	37996	53698	60293	7379	60764	47575	47417	47575
1004 SL	35072	18467	33210	22968	31968	40038	1241	40659	37400	36624	37555
1005 SL	38344	25615	36171	28409	34773	36947	6365	37102	32911	32600	33066
1002 SL	48428	24135	43695	29656	41487	52845	2997	54107	43380	42907	43695
1003 SL	61655	32789	55850	39378	53183	63224	7844	65106	52442	51144	52805
1008 SL	58373	28641	52146	34868	49344	60241	5915	61020	47788	47321	47788

TABLE 2.1.2-VII

STRAIN GAGE DATA - CONTROL POINT 4 VICINITY

GAGE/FATIGUE COND.	12	14	16	18	518	518	20	520	34	537	38	39
1079 SL	-1782	-1296	486	70484	12638	11990	52012	26897	49258	33541	10208	23333
1081 SL	-4107	-3317	-948	60821	8373	7567	44299	21913	41146	28376	7567	16868
1080 SL	-7016	-6201	-2611	76692	11749	11107	56845	28749	52925	36263	11271	25482
1082 SL	-624	-624	1560	65854	9363	8895	48532	23876	45099	30898	9363	21535

GAGE/FATIGUE COND.	539	539	549	51	560	61	561	63	563	88	588
1079 SL	-3565	-4047	-5504	15052	23307	66038	9873	52927	21365	27515	10682
1081 SL	-2995	-3472	-6154	9784	19253	55076	7890	44029	17517	22724	8837
1080 SL	-4900	-5561	-8504	15208	24855	70807	10302	56743	22566	31396	12264
1082 SL	-4057	-4837	-7959	12016	20131	58832	7647	47128	18259	26373	9987

GAGE/FATIGUE COND.	117	617	119	619	122	127	637	148	150	166	169
1079 SL	26706	15052	24116	17641	23631	52118	5664	59887	44996	40464	44996
1081 SL	22409	11835	20042	14203	19253	44029	946	50184	37243	34087	37243
1080 SL	29598	15862	26654	18805	25836	56089	2289	63775	47169	43007	47095
1082 SL	25437	13109	22628	15606	21847	47128	469	53370	39482	36361	39482

SEE NOTES ON TABLE 2.1.2-V.

TABLE 2.1.2-VIII

STRAIN GAGE DATA - CONTROL POINT 5 VICINITY

GAGE/FATIGUE COND.	12	14	16	18	518	518	20	520	34	537	38	39
1071 SL	-11959	-10597	-9537	46474	15138	14215	36597	23440	38865	26162	15879	38866
1072 SL	-18588	-16729	-12082	63045	14560	13617	48280	27235	48744	33425	18569	45649
1073 SL	-15112	-13344	-10771	69241	20096	18970	53536	32475	55304	37941	21703	52732
3007 SL	-11502	-10582	-11041	71313	23771	20683	56380	35697	59597	39987	23900	60670
3007 SR	-11501	-10351	-10515	73279	23166	21008	57937	35780	61055	40539	23962	62204
3008 SL	-4547	-3920	-5331	34496	16778	14723	30700	22711	33050	23965	15036	32736
3009 SL	-3331	-3014	-4600	41723	16023	15229	33790	22685	36487	24589	14753	36487
3010 SL	-12276	-10966	-9820	48774	16203	15221	38954	24715	41082	27988	17022	41573
3011 SL	7415	6771	161	3224	9672	9984	4992	6924	9340	4509	1610	9662
3012 SL	-11655	-10237	-9293	59061	20789	20139	47358	30523	50347	34613	21083	51763
3013 SL	-8247	-7296	-7296	50596	17130	16513	40646	26039	42869	29215	17625	43187
3014 SL	-925	-771	-3237	35919	15416	14645	29907	21120	32836	22045	14491	35457

SEE NOTES ON TABLE 2.1.2-V.

TABLE 2.1.2-VIII Cont'd.

GAGE/FATIGUE COND.	117	617	119	619	122	127	637	148	150	166	169
1071 SL	30063	18431	27646	21150	26891	41998	14049	45927	36862	32934	36711
1072 SL	39150	21664	35436	25533	34043	52767	8047	56482	43947	40852	43638
1073 SL	42121	25240	38584	28938	37780	59323	15916	65433	51767	46944	51445
3007 SL	45195	28037	41978	32326	41212	64959	22215	71853	57452	51170	57145
3007 SR	47709	28527	43610	33117	42626	66727	20821	72957	58038	51972	57710
3008 SL	24304	18032	23206	19757	23363	34966	16621	38573	33712	29635	33555
3009 SL	26017	17291	24113	19195	24271	39025	16815	43784	35534	30934	35217
3010 SL	31916	19641	29297	22259	28806	44192	14894	48447	38954	35026	38791
3011 SL	-1451	2579	-483	1451	1451	9350	19667	13702	12735	7254	12574
3012 SL	37603	22657	34457	25803	33985	52550	19824	58057	46886	41536	46728
3013 SL	32481	20122	30104	22974	29629	45790	15369	50385	40720	36442	40562
3014 SL	24819	16803	23123	18653	23123	35456	17266	39618	32527	28365	32373

TABLE 2.1.2-VIII Cont'd.

GAGE/FATIGUE COND.	539	539	549	51	560	61	561	63	563	88	588
1071 SL	-6049	-5892	-3928	26589	19489	52574	9517	42452	18280	35955	14201
1072 SL	-8047	-8201	-10058	29247	23830	65611	11142	52922	22283	47816	19033
1073 SL	-8199	-8521	-7556	35530	27651	75400	13022	60449	25883	50803	20095
3007 SL	-8273	-8579	-4749	41059	30028	82424	14094	66644	28036	55613	21908
3007 SR	-9354	-8853	-5738	41807	29838	83942	14264	67875	28199	57711	21805
3008 SL	-5169	-5331	-2195	25088	18973	41552	9878	36221	18032	26656	12701
3009 SL	-4442	-5076	-1111	25511	18243	49654	8884	40136	17133	30617	11739
3010 SL	-5729	-6383	-4092	28152	20459	55158	9820	44846	19150	37972	14894
3011 SL	2415	1128	10962	8705	2579	14669	1451	10962	2902	-3708	-4997
3012 SL	-8338	-9912	-6607	35086	24229	66238	11171	53651	22342	44841	16677
3013 SL	-6191	-6813	-4278	29470	21231	57198	9982	46582	19805	38501	15052
3014 SL	-4624	-4933	-770	25436	16957	44860	8324	36227	15878	29135	11408

TABLE 2.1.2-IX

CALCULATED STRESSES FOR CONTROL POINT 6, UPDATED ANALYTIC SPECTRUM

FATIGUE CONDITION	σ GROSS SECTION	FATIGUE COND.	σ GROSS SECTION	FATIGUE COND.	σ GROSS SECTION	FATIGUE COND.	σ GROSS SECTION	FATIGUE COND.	σ GROSS SECTION	FATIGUE COND.	σ GROSS SECTION	FATIGUE COND.	σ GROSS SECTION
1	9.5	524	4.9	48	11.8	77	11.1	98	23.8	619	14.3	143	6.5
501	7.0	25	9.9	548	9.1	577	5.6	598	5.1	120	20.2	144	9.6
2	8.9	525	5.7	49	33.1	78	21.8	99	21.4	620	15.3	644	3.4
502	7.6	26	9.1	549	USE 0	578	4.0	599	7.5	121	21.2	145	8.8
3	12.4	526	7.9	50	27.1	79	19.9	100	19.7	621	5.9	645	4.3
503	4.0	527	6.4	550	USE 0	579	5.9	600	9.2	122	20.0	146	8.1
4	11.8	28	13.5	51	21.8	80	18.4	101	18.6	622	6.4	646	4.9
504	4.7	528	1.2	551	4.0	580	7.3	601	10.2	123	17.9	147	7.5
5	11.1	29	11.5	52	17.3	81	17.2	102	18.5	623	7.4	647	5.6
505	5.3	529	3.2	53	12.0	581	8.6	602	10.5	124	15.4	148	9.1
6	10.6	30	9.8	553	7.4	82	15.9	103	18.2	624	9.1	648	4.5
506	5.9	530	4.9	54	13.7	582	9.8	603	10.9	125	12.2	149	8.4
7	10.0	31	9.0	55	7.3	83	27.4	104	17.7	126	6.8	649	4.9
507	6.5	531	5.8	56	10.3	583	11.0	604	11.4	127	10.3	150	7.8
8	9.5	32	11.7	556	3.5	84	25.8	105	16.9	627	3.7	650	5.2
508	8.2	532	3.7	57	9.8	584	12.6	605	12.1	128	9.4	151	7.2
9	8.9	33	10.8	557	4.3	85	24.4	106	14.5	628	4.3	152	6.5
10	11.5	533	4.5	58	9.0	585	14.0	107	12.2	129	8.6	652	5.6
510	8.4	34	9.9	558	5.0	86	24.3	108	13.4	629	4.5	153	5.0
12	14.8	534	5.2	59	8.4	586	15.4	608	1.4	130	7.8	154	8.8
512	5.2	35	8.8	60	7.3	87	22.1	109	12.1	131	6.8	654	2.6
13	13.9	36	7.4	560	5.6	587	16.4	609	2.7	631	5.4	155	8.3
513	6.1	536	5.8	61	12.0	88	31.1	110	10.9	132	10.7	655	3.1
14	13.2	37	7.4	561	3.6	588	12.9	610	3.9	632	3.6	156	7.9
514	6.8	38	13.7	62	11.0	89	26.5	111	9.9	133	9.8	656	3.5
15	12.3	39	33.3	562	4.5	90	23.6	611	5.0	633	4.2	157	7.5
515	7.7	539	USE 0	63	10.1	590	6.9	113	18.8	134	8.9	657	3.9
16	11.5	40	27.4	563	5.3	91	22.7	613	5.5	634	4.9	158	7.0
516	10.0	540	.8	64	9.0	591	7.4	114	17.3	135	8.0	658	4.4
17	10.8	41	22.2	65	7.4	92	21.1	614	6.9	136	6.8	159	6.5
18	11.9	541	4.9	565	6.0	592	7.6	115	16.0	636	5.3	659	5.7
518	6.3	42	17.9	71	7.9	93	19.3	615	8.2	137	7.2	160	6.1
19	11.0	43	13.7	72	12.9	593	8.2	215	15.0	637	.8	161	6.5
519	7.1	543	8.3	73	16.5	94	17.4	715	9.2	138	6.3	661	4.9
20	10.2	44	25.7	573	.2	594	9.0	116	14.4	638	1.4	162	6.1
520	7.7	544	1.3	74	14.8	95	15.6	616	9.8	139	5.6	662	5.3
21	9.1	45	21.7	574	2.0	595	10.2	117	23.9	639	1.6	164	6.5
22	8.0	545	4.6	75	13.4	96	29.5	617	11.6	140	4.8	165	6.8
23	11.9	46	17.9	575	3.2	596	USE 0	118	22.5	141	3.9	666	4.9
523	3.8	546	7.2	76	12.0	97	26.5	618	13.0	641	2.4	683	5.0
24	10.8	47	14.6	576	4.5	597	2.5	119	21.3	142	6.8		

NOTES: 1) Stresses in KSI.

2.1.2.6 Full Scale Test Data

The previous interim report discussed test data obtained during the static strain surveys. Subsequent to that time, 1280 fatigue flights have been accomplished. A large amount of data was recorded and transmitted to General Dynamics. This section discusses portions of the test data and its ramifications. For brevity, only a small amount of the actual data is included.

During the first flight, data was recorded at all of the data points given in Table 2.1.2-VII of AFFDL-TR-76-8. During the fifth flight the points of Table 2.1.2-VIII of AFFDL-TR-76-8 were recorded. For both of these flights approximately 420 strain gage channels were available for use. Typical explanatory notes and output data as received from AFFDL are shown in Table 2.1.2-X. The strain data for both the first and fifth flights was reviewed and compared with data for similar conditions from the static strain survey. Although some stress levels exceeded those previously predicted at the gage locations, no indications were obtained that precluded continued testing.

Following the fifth flight, exceedance data was obtained for most flights using fifth flight data as a baseline. Typical exceedance data is shown in Table 2.1.2-XI. The exceedance printout serves as one means of monitoring the structure since significant changes from fifth flight values indicate possible problems.

Because of a higher priority, two Real Time Peripheral (RTP) units became unavailable so that for flight 160 only about 170 channels of strain gage data were recorded. The data was obtained for the points specified in Table 2.1.2-IX of AFFDL-TR-76-8.

During the inspection following flight 160, the pivot pins, bushings, and spacers at the juncture between the WCTS lugs and the dummy wing were found to have rotated considerably from their initial positions. (See Section 2.2.1) Several gages on the lugs showed significant changes from the early flights to flight 160. (Ref. Figures 2.1.2-3 and 2.1.2-4 and Tables 2.1.2-XII and 2.1.2-XIII.) Since one of the effects of the rotated bushings was to bend the lugs, it was concluded that the stress changes were probably due to geometry changes resulting from lug distortion. Unfortunately, continuous zero shift data was not obtained so preload stresses resulting from lug bending caused by bushing rotation were not available.

AMAVS TEST HISTORY

FLIGHT NO. 1280

TEST SERIAL NUMBER 1280 DATE: 30 MARCH 1976

TEST TIME (SEC)	REMARKS
769 - 775	Zero load recorded with all data channels balanced and AMAVS on jacks.
1257 - 1264	100% Counter Balance Loads with AMAVS off jacks.
1747 - 1755	All data channels rebalanced at zero load except Counter Balance Loads with AMAVS off jacks at 100% Counter Balance Load.
	Fatigue cycling started at Level 141-142, cycle 7, of Flight No. 1269 and continued to the completion of Flight No. 1279.
17669 - 17673	Record Level Zero at end of Flight No. 1279. All data channels rebalanced at zero load except Counter Balance Loads at beginning of Flight No. 1280.
18706 - 18715	Record Level zero at beginning of Flight No. 1280 with AMAVS WCTS Tank pressurized.
	Fatigue cycling continued at beginning of Flight No. 1280; data sampling rate at 1 sample per second during Flight No. 1280. Data automatically recorded (2 samples) by the SEL-86 Data Computer when flag received from Program Control Mini-Computer that plateau is reached on the baseline data points.

TEST TIME (SEC)	POINT DESIGNATION	FATIGUE CONDITION	DATA POINT NUMBER	STEP NUMBER	LEVEL NUMBER
18791 - 18792	53	14	1-2	7	013 (MAXIMUM)
18800 - 18801		16	1-3	8	015 (MAXIMUM)
18843 - 18844	54	20	1-8	11	021 (MAXIMUM)
18944 - 18945	55	34	1-10	25	049 (MAXIMUM)
19073 - 19074	56	51	1-17	39	077 (MAXIMUM)
19147 - 19148	57	63	1-21	49	097 (MAXIMUM)

TYPICAL TEST DATA

TABLE 2.1.2-X

AMAVS TEST HISTORY

FLIGHT NO. 1280

TEST SERIAL NUMBER 1280 (CONTINUED)

TEST TIME (SEC)	POINT DESIGNATION	FATIGUE CONDITION	DATA POINT NUMBER	STEP NUMBER	LEVEL NUMBER
19288 - 19289	58	88	1-23	67	133 (MAXIMUM)
19957 - 19958	59	119	1-28	89	177 (MAXIMUM)
19978 - 19979	60	122	1-30	91	181 (MAXIMUM)
20310 - 20311	61	150	1-34	112	223 (MAXIMUM)
20405 - 20406	62	166	1-35	122	243 (MAXIMUM)
20426 - 20427		169	1-36	125	249 (MAXIMUM)
20594 - 20604	Zero record at end of Flight No. 1280, with 100% Counter Balance Loads.				
20782 - 20788	Record zero with AMAVS on jacks and Counter Balance Loads off.				

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TABLE 2.1.2-X Cont'd.

S/N 1280 MONTH 03 DAY 30 YEAR 76 CHAN 1 1 TRANSDUCER 1003 SL PAGE 1

TIME(SEC)	MICROVOLTS	PSI	TIME(SEC)	MICROVOLTS	PSI	TIME(SEC)	MICROVOLTS	PSI
769.757	0.000	0.000	19289.812	9965.805	72766.750	0.000	0.000	0.000
770.757	-24.426	-178.350	19957.926	7205.668	52613.223	0.000	0.000	0.000
771.757	0.000	0.000	19958.926	7523.203	54931.773	0.000	0.000	0.000
772.757	-24.426	-178.350	19978.961	6888.129	50294.676	0.000	0.000	0.000
773.757	0.000	0.000	19979.961	7376.648	53861.676	0.000	0.000	0.000
774.757	0.000	0.000	20310.023	7474.352	54575.074	0.000	0.000	0.000
775.757	-24.426	-178.350	20311.023	7620.910	55645.168	0.000	0.000	0.000
1257.828	219.834	1605.150	20405.062	6888.129	50294.676	0.000	0.000	0.000
1258.828	244.260	1783.500	20406.062	7718.613	56358.562	0.000	0.000	0.000
1259.828	244.260	1783.500	20426.098	6595.016	48154.469	0.000	0.000	0.000
1260.828	244.260	1783.500	20427.098	7767.465	56715.262	0.000	0.000	0.000
1261.828	244.260	1783.500	20594.145	48.852	356.700	0.000	0.000	0.000
1262.828	244.260	1783.500	20595.145	73.278	535.050	0.000	0.000	0.000
1263.828	244.260	1783.500	20596.145	97.704	713.400	0.000	0.000	0.000
1264.828	244.260	1783.500	20597.145	73.278	535.050	0.000	0.000	0.000
1747.622	97.704	713.400	20598.145	73.278	535.050	0.000	0.000	0.000
1748.622	97.704	713.400	20599.145	73.278	535.050	0.000	0.000	0.000
1749.623	97.704	713.400	20600.145	97.704	713.400	0.000	0.000	0.000
1750.623	97.704	713.400	20601.145	73.278	535.050	0.000	0.000	0.000
1751.623	97.704	713.400	20602.145	73.278	535.050	0.000	0.000	0.000
1752.623	73.278	535.050	20603.145	73.278	535.050	0.000	0.000	0.000
1753.623	73.278	535.050	20604.145	73.278	535.050	0.000	0.000	0.000
1754.623	73.278	535.050	20782.160	0.000	0.000	0.000	0.000	0.000
1755.623	73.278	535.050	20783.160	0.000	0.000	0.000	0.000	0.000
17669.801	219.834	1605.150	20784.160	0.000	0.000	0.000	0.000	0.000
17671.801	219.834	1605.150	20785.160	-24.426	-178.350	0.000	0.000	0.000
17673.801	219.834	1605.150	20786.160	0.000	0.000	0.000	0.000	0.000
18706.273	73.278	535.050	20787.160	-24.426	-178.350	0.000	0.000	0.000
18707.273	73.278	535.050	20788.160	-24.426	-178.350	0.000	0.000	0.000
18708.273	73.278	535.050	0.000	0.000	0.000	0.000	0.000	0.000
18709.273	73.278	535.050	0.000	0.000	0.000	0.000	0.000	0.000
18710.273	73.278	535.050	0.000	0.000	0.000	0.000	0.000	0.000
18711.273	73.278	535.050	0.000	0.000	0.000	0.000	0.000	0.000
18712.273	73.278	535.050	0.000	0.000	0.000	0.000	0.000	0.000
18713.273	48.852	356.700	0.000	0.000	0.000	0.000	0.000	0.000
18714.273	48.852	356.700	0.000	0.000	0.000	0.000	0.000	0.000
18715.273	73.278	535.050	0.000	0.000	0.000	0.000	0.000	0.000
18791.012	-1392.282	-10165.945	0.000	0.000	0.000	0.000	0.000	0.000
18792.012	-1319.004	-9630.898	0.000	0.000	0.000	0.000	0.000	0.000
18800.012	-659.502	-4815.449	0.000	0.000	0.000	0.000	0.000	0.000
18801.012	-635.076	-4637.098	0.000	0.000	0.000	0.000	0.000	0.000
18843.773	8158.281	59568.867	0.000	0.000	0.000	0.000	0.000	0.000
18844.773	8475.816	61887.414	0.000	0.000	0.000	0.000	0.000	0.000
18944.781	8426.965	61530.715	0.000	0.000	0.000	0.000	0.000	0.000
18945.781	8573.523	62600.809	0.000	0.000	0.000	0.000	0.000	0.000
19073.793	6472.887	47262.715	0.000	0.000	0.000	0.000	0.000	0.000
19074.793	6472.887	47262.715	0.000	0.000	0.000	0.000	0.000	0.000
19147.801	8915.484	65097.715	0.000	0.000	0.000	0.000	0.000	0.000
19148.801	8915.484	65097.715	0.000	0.000	0.000	0.000	0.000	0.000
19288.812	9941.379	72588.437	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 2.1.2-X Cont'd.

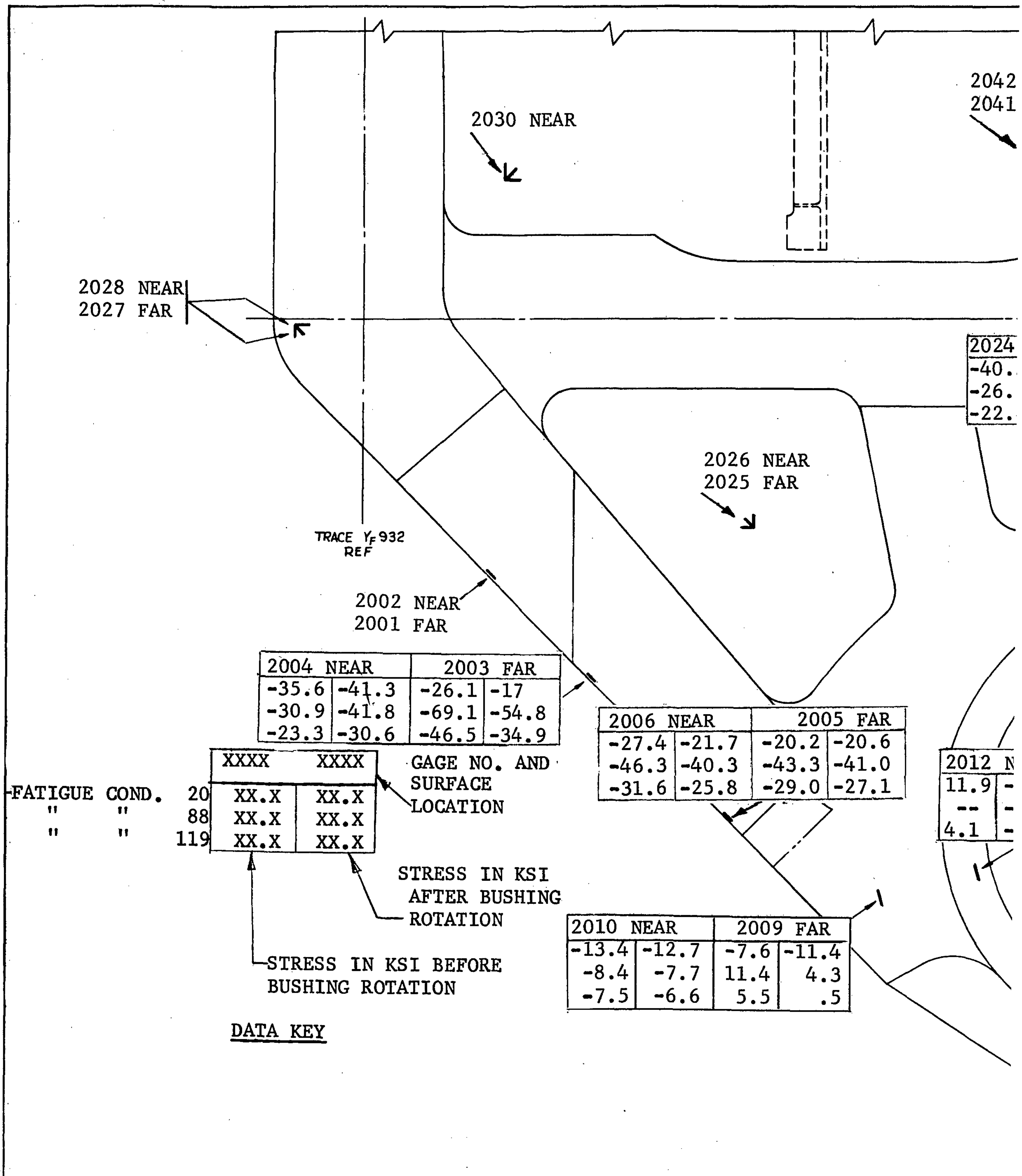
FLIGHT #580

								(1)	
EXCEEDANCE FRROR	7001	PL	DATA VALUE	9464.66	BASELINE VALUE	7045.38		STEP	15
EXCEEDANCE FRROR	9001	VL	DATA VALUE	-582.07	BASELINE VALUE	-1282.44		STEP	15
EXCEEDANCE FRROR	1003	SL	DATA VALUE	-4083.34	BASELINE VALUE	-6888.71		STEP	15
EXCEEDANCE FRROR	1004	SL	DATA VALUE	-1755.14	BASELINE VALUE	-620.75		STEP	15
EXCEEDANCE FRROR	1005	SL	DATA VALUE	-3104.81	BASELINE VALUE	-4967.70		STEP	15
EXCEEDANCE FRROR	1015	SL	DATA VALUE	-156.37	BASELINE VALUE	-1558.98		STEP	15
EXCEEDANCE FRROR	1017	SL	DATA VALUE	1848.73	BASELINE VALUE	-923.43		STEP	15
EXCEEDANCE FRROR	1025	SL	DATA VALUE	-4358.89	BASELINE VALUE	-1614.40		STEP	15
EXCEEDANCE FRROR	1027	SL	DATA VALUE	615.55	BASELINE VALUE	1998.52		STEP	15
EXCEEDANCE FRROR	1028	SL	DATA VALUE	-4527.54	BASELINE VALUE	-3125.64		STEP	15
EXCEEDANCE ERROR	1029	SL	DATA VALUE	-2987.30	BASELINE VALUE	-4636.85		STEP	15
EXCEEDANCE FRROR	1030	SL	DATA VALUE	-5673.44	BASELINE VALUE	-9334.31		STEP	15
EXCEEDANCE FRROR	1031	SL	DATA VALUE	-2865.43	BASELINE VALUE	1590.26		STEP	15
EXCEEDANCE FRROR	1033	SL	DATA VALUE	-6067.63	BASELINE VALUE	-2874.14		STEP	15
EXCEEDANCE FRROR	1038	SL	DATA VALUE	3405.00	BASELINE VALUE	7843.09		STEP	15
EXCEEDANCE FRROR	1045	SL	DATA VALUE	-5989.80	BASELINE VALUE	-3561.51		STEP	15
EXCEEDANCE FRROR	1075	SL	DATA VALUE	-348.96	BASELINE VALUE	-1222.59		STEP	15
EXCEEDANCE FRROR	1080	SL	DATA VALUE	-1796.86	BASELINE VALUE	-2613.62		STEP	15
EXCEEDANCE FRROR	1110	SL	DATA VALUE	-1429.03	BASELINE VALUE	-2147.99		STEP	15
EXCEEDANCE FRROR	1123	SL	DATA VALUE	1701.45	BASELINE VALUE	1253.70		STEP	15
EXCEEDANCE FRROR	3008	SL	DATA VALUE	-4229.25	BASELINE VALUE	-5639.00		STEP	15
EXCEEDANCE FRROR	3011	SL	DATA VALUE	0.00	BASELINE VALUE	1128.41		STEP	15
EXCEEDANCE FRROR	3012	SL	DATA VALUE	-5506.71	BASELINE VALUE	-8653.40		STEP	15
EXCEEDANCE FRROR	4011	SL	DATA VALUE	619.73	BASELINE VALUE	1705.99		STEP	15
EXCEEDANCE FRROR	8016	SL	DATA VALUE	-1481.89	BASELINE VALUE	-1152.58		STEP	15

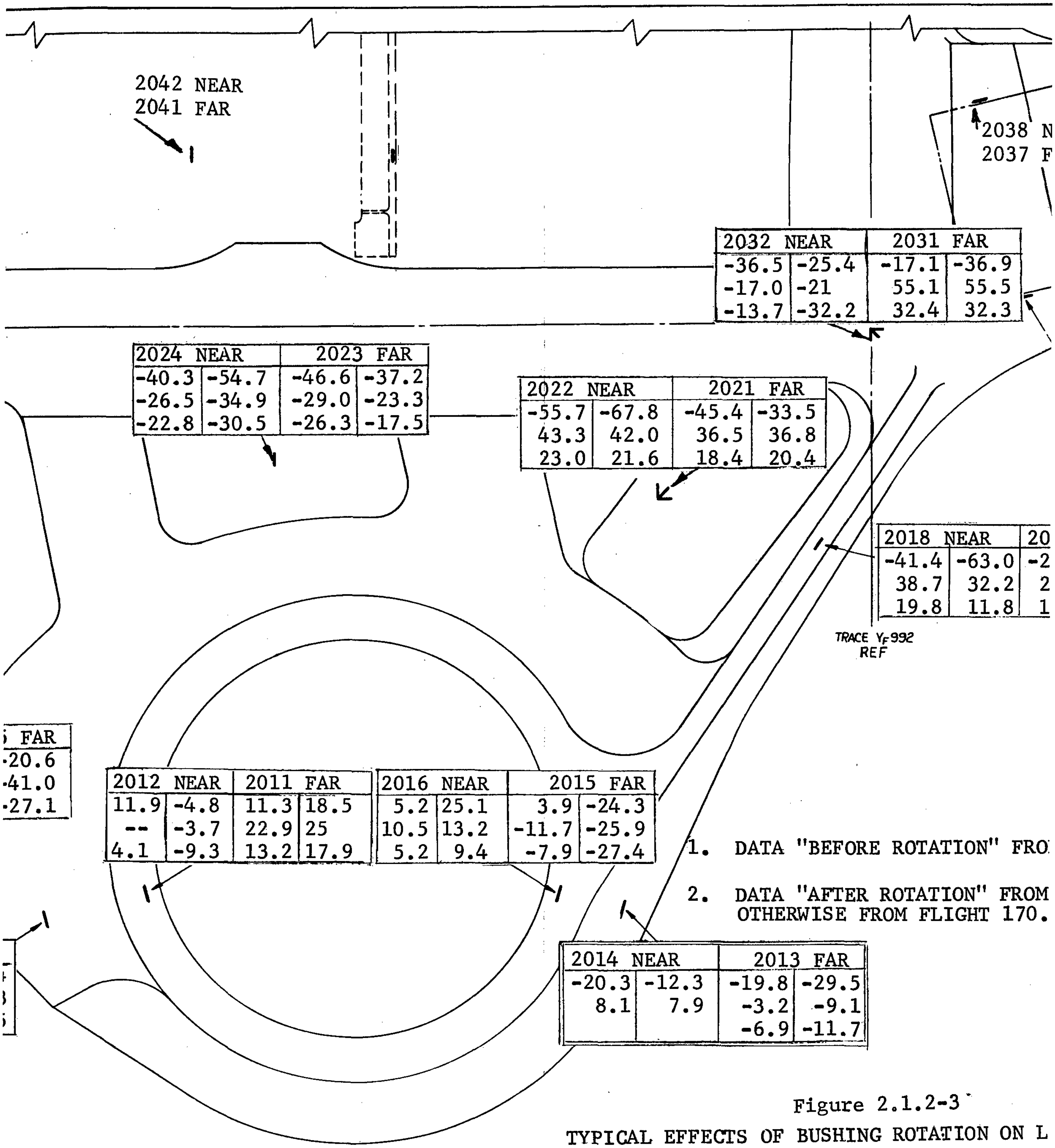
NOTES: (1) STEP CORRESPONDS TO LEVEL

TYPICAL EXCEEDANCE DATA

TABLE 2.1.2-XI



2030 NEAR
2042
2041
2028 NEAR
2027 FAR
2024
2026 NEAR
2025 FAR
TRACE Y_F 932 REF
2002 NEAR
2001 FAR
2004 NEAR | 2003 FAR
-35.6 | -41.3 | -26.1 | -17
-30.9 | -41.8 | -69.1 | -54.8
-23.3 | -30.6 | -46.5 | -34.9
2006 NEAR | 2005 FAR
-27.4 | -21.7 | -20.2 | -20.6
-46.3 | -40.3 | -43.3 | -41.0
-31.6 | -25.8 | -29.0 | -27.1
2012
11.9
--
4.1
XXXX | XXXX
FATIGUE COND. 20 | XX.X | XX.X
" " 88 | XX.X | XX.X
" " 119 | XX.X | XX.X
GAGE NO. AND SURFACE LOCATION
STRESS IN KSI AFTER BUSHING ROTATION
STRESS IN KSI BEFORE BUSHING ROTATION
DATA KEY
2010 NEAR | 2009 FAR
-13.4 | -12.7 | -7.6 | -11.4
-8.4 | -7.7 | 11.4 | 4.3
-7.5 | -6.6 | 5.5 | .5

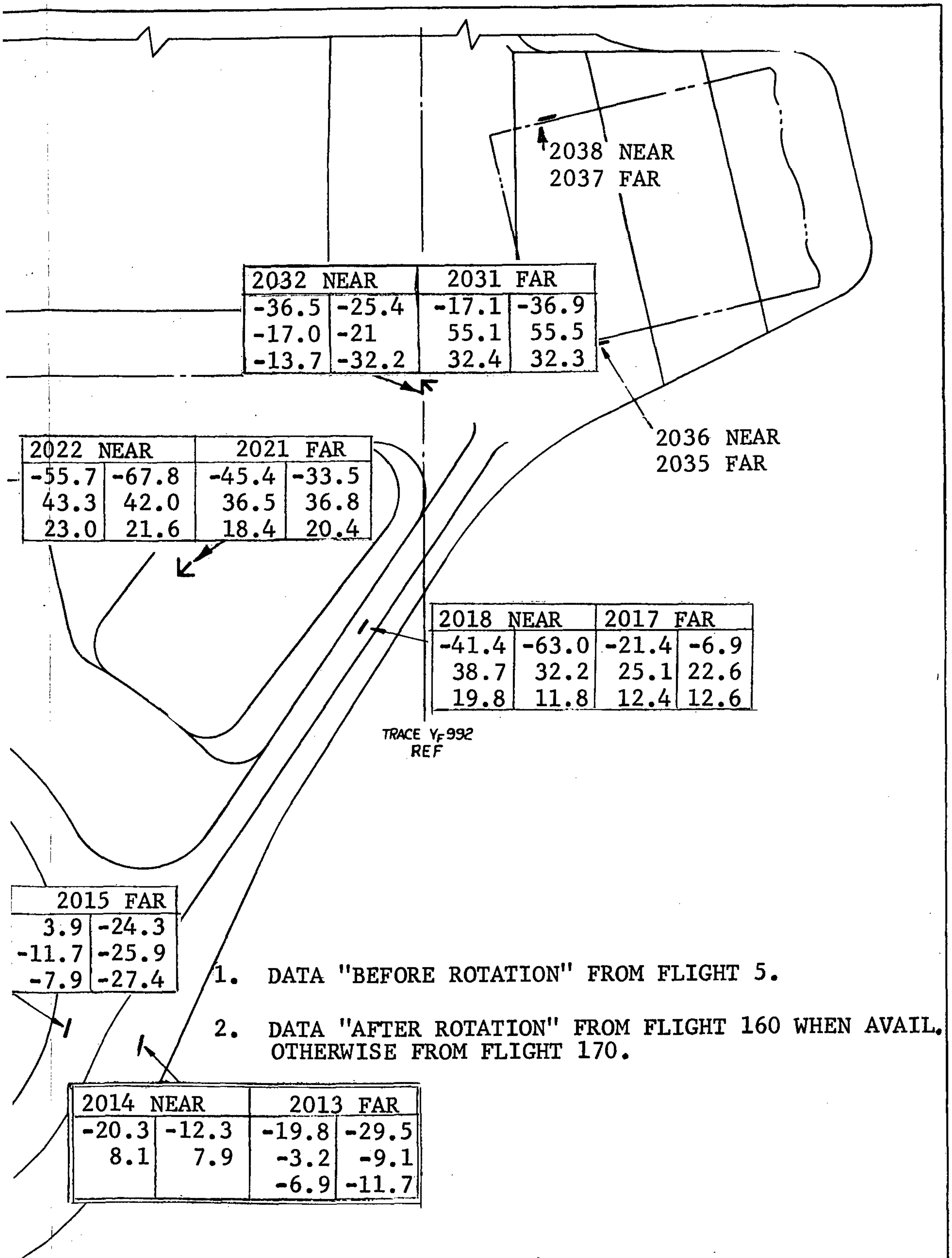


1. DATA "BEFORE ROTATION" FRO

2. DATA "AFTER ROTATION" FROM
OTHERWISE FROM FLIGHT 170.

Figure 2.1.2-3

TYPICAL EFFECTS OF BUSHING ROTATION ON L
AMAVS UPPER LUG

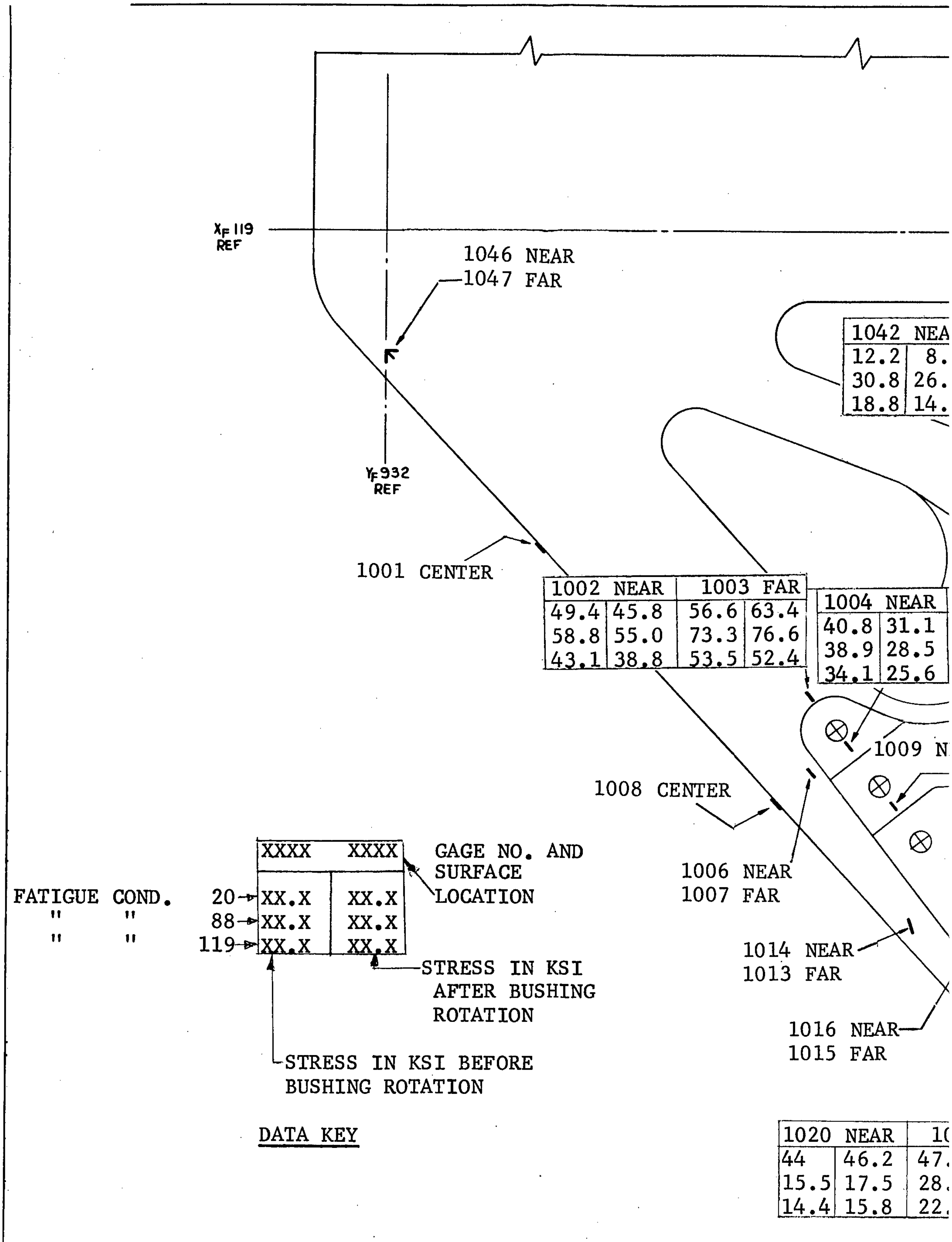


1. DATA "BEFORE ROTATION" FROM FLIGHT 5.

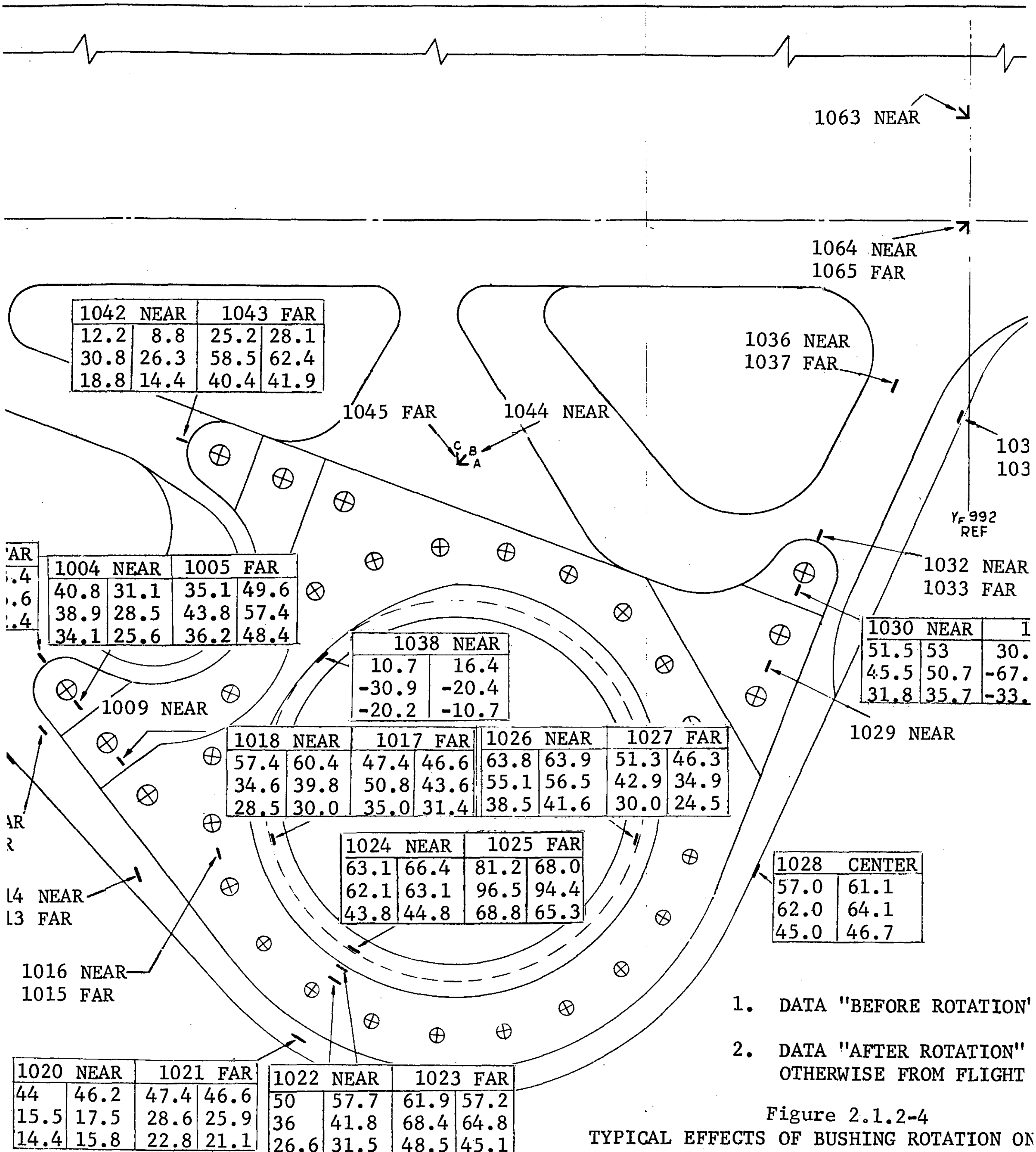
2. DATA "AFTER ROTATION" FROM FLIGHT 160 WHEN AVAIL. OTHERWISE FROM FLIGHT 170.

Figure 2.1.2-3

TYPICAL EFFECTS OF BUSHING ROTATION ON LUG STRESSES
AMAVS UPPER LUG



X_F 119 REF
Y_F 932 REF
1046 NEAR
1047 FAR
1042 NEA
12.2 8.
30.8 26.
18.8 14.
1001 CENTER
1002 NEAR
49.4 45.8
58.8 55.0
43.1 38.8
1003 FAR
56.6 63.4
73.3 76.6
53.5 52.4
1004 NEAR
40.8 31.1
38.9 28.5
34.1 25.6
1009 N
1008 CENTER
1006 NEAR
1007 FAR
1014 NEAR
1013 FAR
1016 NEAR
1015 FAR
1020 NEAR
44 46.2
15.5 17.5
14.4 15.8
1(
47.
28.
22.
XXXX XXXX
GAGE NO. AND SURFACE LOCATION
FATIGUE COND. 20 XX.X XX.X
" " 88 XX.X XX.X
" " 119 XX.X XX.X
STRESS IN KSI AFTER BUSHING ROTATION
STRESS IN KSI BEFORE BUSHING ROTATION
DATA KEY



1042 NEAR		1043 FAR	
12.2	8.8	25.2	28.1
30.8	26.3	58.5	62.4
18.8	14.4	40.4	41.9

1004 NEAR		1005 FAR	
40.8	31.1	35.1	49.6
38.9	28.5	43.8	57.4
34.1	25.6	36.2	48.4

1038 NEAR	
10.7	16.4
-30.9	-20.4
-20.2	-10.7

1030 NEAR		1
51.5	53	30.
45.5	50.7	-67.
31.8	35.7	-33.

1018 NEAR		1017 FAR	
57.4	60.4	47.4	46.6
34.6	39.8	50.8	43.6
28.5	30.0	35.0	31.4

1026 NEAR		1027 FAR	
63.8	63.9	51.3	46.3
55.1	56.5	42.9	34.9
38.5	41.6	30.0	24.5

1024 NEAR		1025 FAR	
63.1	66.4	81.2	68.0
62.1	63.1	96.5	94.4
43.8	44.8	68.8	65.3

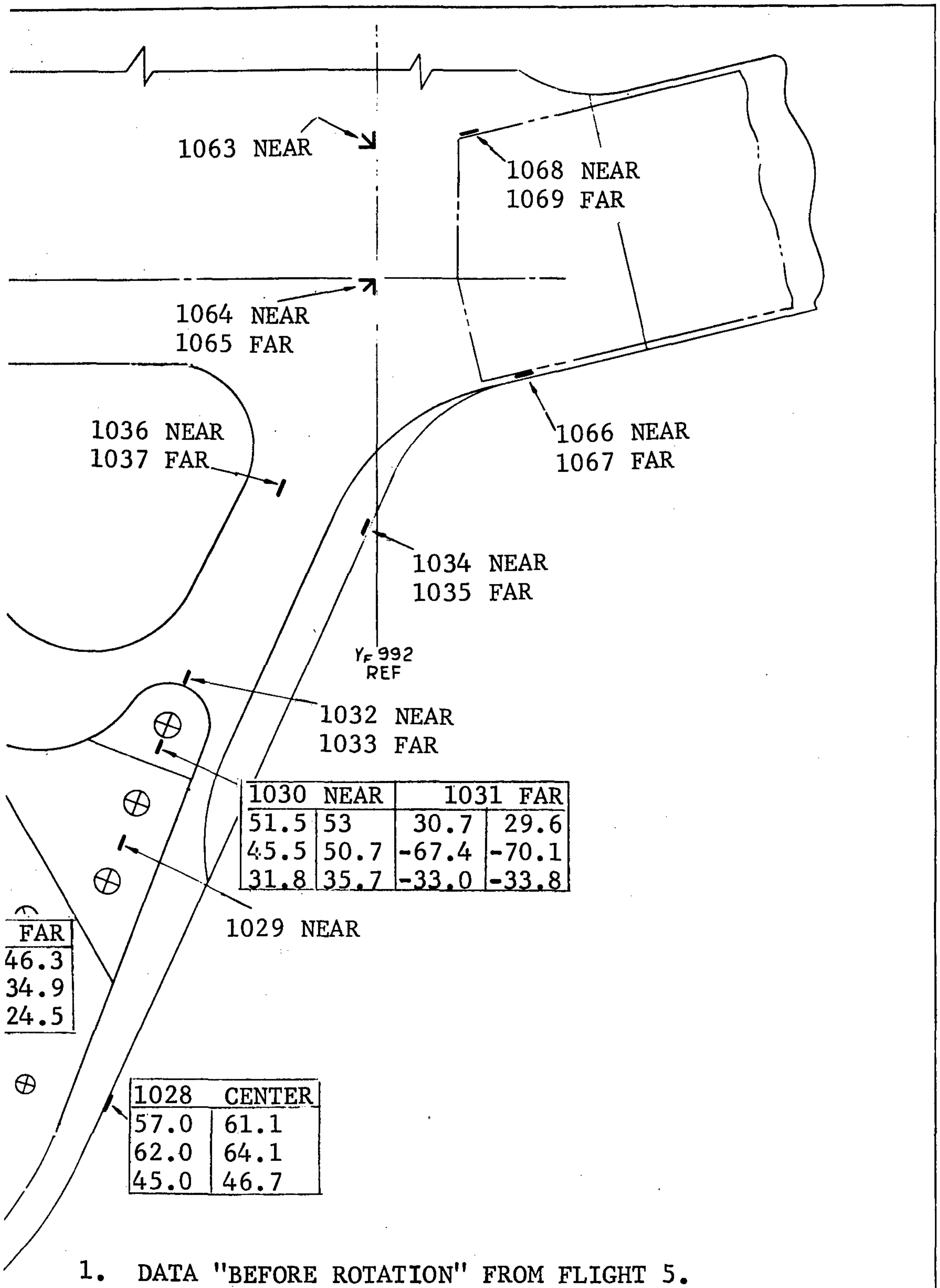
1028 CENTER	
57.0	61.1
62.0	64.1
45.0	46.7

1020 NEAR		1021 FAR	
44	46.2	47.4	46.6
15.5	17.5	28.6	25.9
14.4	15.8	22.8	21.1

1022 NEAR		1023 FAR	
50	57.7	61.9	57.2
36	41.8	68.4	64.8
26.6	31.5	48.5	45.1

1. DATA "BEFORE ROTATION'
2. DATA "AFTER ROTATION" OTHERWISE FROM FLIGHT

Figure 2.1.2-4
TYPICAL EFFECTS OF BUSHING ROTATION ON AMAVS LOWER LUG



1030 NEAR		1031 FAR	
51.5	53	30.7	29.6
45.5	50.7	-67.4	-70.1
31.8	35.7	-33.0	-33.8

FAR
46.3
34.9
24.5

1028	CENTER
57.0	61.1
62.0	64.1
45.0	46.7

1. DATA "BEFORE ROTATION" FROM FLIGHT 5.

2. DATA "AFTER ROTATION" FROM FLIGHT 160 WHEN AVAILABLE. OTHERWISE FROM FLIGHT 170.

Figure 2.1.2-4
EFFECTS OF BUSHING ROTATION ON LUG STRESSES
AMAVS LOWER LUG

TABLE 2.1.2-XII

LOWER LUG STRESS COMPARISONS

GAGE	COND. FLT.	BAL. ZERO LD.	F/C 14	16	20	34	51	63	88	119	122	150	166	169
1002	1	-.5/-.3	-7.1/-7.3	-3.3/-3.2	49.7	49.9/50.2	35.0	51.9	59.2/59.3	43.2/43.4	41.0/41.3	43.1	42.6	43.4
	5	.3	-5.8/-6.0	-2.2/-2.4	49.2/49.4	49.5/49.7	35.3/35.7	51.9/52.1	58.7/58.8	42.7/43.1	40.9/41.0	43.2/43.4	42.6	43.4/43.5
	160	.2	-2.2	.2	43.9/45.8	40.6/43.9	29.7/33	43.6/46.9	50.8/55.0	39.5/38.8	35.4/38.4	35.7/41.1	32.8/40.4	35.8/51.1
	170	Not Available												
	190	0 /.3	-6.3/-6.8	-3.2/-2.8	47.7/46.6	48.2	28.1/34.1	47.5/51.8	56.2/54.7	38.5/40.3	37.4/39.2	38.4/43.1	36.6/42.6	41.1/41.7
	320	0	-6.8/-6.9	-3.3/-2.4	46.1/47.7	48.2/47.2	26.7/33.3	48.3/51.0	50.5/55.6	39.9/39.5	34.9/39.0	40.6/42.8	37.4/42.5	40.1/42.3
1004	1	0	-5.9/-5.7	-1.9	39.3	38.8	22.6	38.8	37.3	32.9	31.5	36.9	36.3	37.2
	5	.6	-4.3/-4.0	-.6	40.8	39.7	25.6/25.9	41.0	28.8/38.9	34.3/34.1	33.2/33.5	38.5	37.7/37.9	38.5
	160	-.2	-1.6	.18	30.4/31.1	29.2/30.2	20.2/31.8	29.7/30.8	27.6/28.5	26/25.6	24.8/25.6	28.1/29.4	27.2/29.2	27.9/29.2
	170	-.5	-4/-4.1	-1.6/-1.1	32.4/32.1	31.2/31.9	20.4/23.3	31.7/33.2	30.3/30.9	26.1/27.1	26.9/26.6	29.5/30.9	30/29.5	29.6/30.8
	190	-.5/-.2	-6.9/-7.2	-3.2/-3.5	37.7/36.9	36.9/36.4	19.5/23.5	37.2/38.3	35.3/34.6	29.4/30.3	28.9/29.8	34.1/35.9	32.9/35.3	34.9
	320	.5	-6.3/-6.4	-2.4/1.6	38.5/38.8	38.3/37.4	19.3/24.3	38.5/39.1	34.8/36.1	31.5/31.3	28.8/31.5	36.4/36.9	34.7/36.4	36.1/36.6
1005														
	1	-.2	-5.9	-2.5	36.3	37.7	33.8	36.0	43.6	36.1	34.6	32.9	32.6	33.1
	5	0	-8.4/-8.2	-5.0	35.1	35.9/36.0	34.2/34.0	37.0	43.6/43.8	36.0/36.2	35.0/35.1	33.4	33.0/33.1	33.1/33.2
	160	.6	-14.8/-14.6	-9.0	48.7/49.6	48.2/49.9	47.1/48.7	49.3/51.0	55.8/57.4	49.8/48.4	47.9/48.7	44.6/47.8	43.1/48.4	45.4/48.2
	170	.3	-10.9/-11.7	-7.1/-6.7	47.9/47.4	48.6/49.0	45.4/46.6	48.2/50.3	54.5/55.2	47.2/46.9	47.2/45.7	44.0/46.0	46.2/44.8	44.4/46.2
	190	-.3/-.8	-7/-8.1	-3.9	43.6/42.5	45.3/44.2	41.0/43.6	44.9/46.3	52.5/50.6	43.3/44.1	43.2/43.3	40.4/42.1	40.1/42.7	41.9/41.4
	320	.4	-6.7/-6.8	-3.4/-2.3	44.9/45.2	46.9/45.0	41.9/44.9	46.1/47.3	51.7/54.0	45.8/44.9	43.8/45.3	42.8/43.3	42.1/44.1	43.2/43.5
1017	1	-.5	2.2	1.1	48.1/48.2	49.6/49.3	30.5/30.6	51.7	55.6	37.8/38.0	35.4/35.6	40.8/40.9	40.3	42.0
	5	0	.2	-.8/-.9	47.4	48.2/48.3	26.6/27.0	50.2	50.8	34.8/35.0	32.8/33.0	40.0/40.2	38.8	40.5/40.6
	160	0	7.5	5.1	46.6/49.1	40.8/45.4	21.5/24.9	44.2/48.4	43.2/48.0	32.0/31.4	28.0/30.9	36.0/42.6	29.5/38.6	36.2/41.7
	170	0	6.6	5.7/5.4	50.6	48.2/50.6	22.3/26.0	47.9/54.3	43.6/46.5	32.6/33.1	31.9	38.6/44.2	40.3/44.2	38.9/44.2
	190	-.3	.6	.5/.6	45.2/46.3	47.9/47.7	23.9/29.7	46.8/51.7	52.6/51.6	33.9/35.2	32.3/34.2	35.7/40.9	33.9/40.2	39.6/40.2
	320	0	.3	.5/.3	42.6/44.3	46.2/45.1	20.5/26.5	45.9/48.9	43.2/48.9	33.1/32.9	27.9/31.9	36.3/38.6	32.6/38.2	36.6/38.9
1025														
	1	-.6	.6/.8	1.3/1.5	80.0	81.1/81.3	60.1	85.5	97.9	70.9/71.1	67.2/67.4	69.5	70.1/70.0	71.4
	5	.5	-2.4	-1.6	81.2	83.3	59.1/59.4	84.8/84.9	96.5	68.8	65.5/65.7	67.0/67.1	68.0	69.7
	160	.2	-.5/-.3	-.5	68.0/71.3	63.2/69.3	48.3/54.1	68.0/74.2	87.1/94.4	65.3/64.6	57.5/62.4	55.1/64.2	48.0/60.6	54.3/62.7
	170	-.5	.6	.3	71.1/72.7	71.3/75.8	53.3/60.8	70.9/80.2	95.4/99.6	67.1/68.4	64.3/64.5	57.4/64.6	59.1/61.1	56.2/63.5
	190	-.7/-.8	-2.1	-1.9	71.0/71.2	74.1/75.6	48.1/57.8	72.3/79.6	94.1/92.3	62.6/65.4	60.7/63.8	56.8/64.4	62.6/53.0	60.5/62.3
	320	-.3	-2.4	-1.9/-2.1	69.7/72.9	75.0/75.5	46.5/56.9	75.0/80.0	86.0/94.5	60.6/66.3	57.9/64.5	61.4/65.5	55.6/63.8	60.6/64.8

TABLE 2.1.2-XII (Cont'd.)

GAGE	COND. FLT.	BAL. ZERO LD.	F/C 14	16	20	34	51	63	88	119	122	150	166	169
1027	1	-.2	1.5	1.5/1.4	53.8	51.8	22.0	55.9	42.2	31.7	29.9	46.1	40.5	44.5
	5	-.2	2.6/2.5	2.0	51.2/51.3	48.4/48.3	21.7/21.8	52.4/52.3	42.7/42.9	29.8/30.0	28.3/28.4	43.4/43.5	37.8/37.7	42.3/42.4
	160	.2	1.5	1.5	44.0/46.3	35.7/40.2	14.2/16.3	38.5/43.2	31.8/34.9	24.6/24.5	22.0/24.3	33.1/38.9	26.9/34.0	31.4/36.9
	170	-.2	.2	.2	49.2/50.5	43.2/46.9	12.9/16.2	43.2/50.3	32.6/34.8	23.1/23.8	23.2/23.7	34.8/40.2	36.3/36.9	35.9/41.2
	190	.5/.6	2.6/2.8	2.5/2.3	47.9/47.7	45.9/46.9	16.3/20.0	45.1/50.3	36.5/36.6	25.1/26.0	24.0/25.7	33.9/40.2	31.5/36.5	37.7/39.4
	320	-1.4	.3	-.3	40.3/42.0	38.0/38.4	13.4/17.1	38.4/41.7	28.9/32.9	21.7/21.8	18.6/21.1	32.0/33.7	27.2/30.7	30.4/33.1
1033	1	.2	-7.3/-7.5	-3.4/-3.5	54.5/54.8	44.1/44.9	-74.4/-75.0	46.1/46.5	-82.7/-83.5	-39.3/-39.6	-36.4/-36.1	42.5/42.2	31.0/31.1	41.8/42.3
	5	-.5	-7.8/-7.2	-3.5/-2.9	54.0/53.7	43.6/43.1	-72.3/-71.4	46.1/46.0	-80.5/-80.2	-37.7/-37.0	-35.0/-33.4	42.5/42.2	31.6/31.3	42.5/42.0
	160	.2	-6.2/-7.7	-4.3	52.5/55.4	38.2/43.4	-70.7/-74.4	41.3/46.4	-75.7/-78.6	-38.4/-36.0	-34.6/-34.1	36.2/43.0	28.0/34.4	38.9/43.0
	170	.2/.3	-2.7/-4.0	0 /-.3	53.0/52.2	42.3/48.8	-65.8/-66.6	42.8/46.8	-73.4/-73.1	-34.3/-34.6	-32.2/-30.0	37.4/42.0	32.4/31.4	37.4/42.3
	190	0 /.3	-9.7/-10.9	-5.9/-6.9	55.6/53.2	45.5/44.2	-67.7/-73.8	45.0/48.0	-81.0/-77.8	-37.8/-39.4	-35.4/35.9	37.8/44.1	29.9/33.7	42.0/43.0
	320	0	-9.3/-11.2	-6.6/-6.2	53.9/55.6	46.5/44.6	-65.7/-70.5	47.3/48.1	-73.2/-78.0	-37.7/-35.8	-33.2/-33.6	42.5/43.6	22.1/34.8	42.3/44.5
1038	1	-.3/-.5	9.0	6.4/6.6	4.7	-4.1/-4.2	-24.5	-2.7	-31.6/-31.9	-20.6/-20.9	-18.8/-19.0	1.6	-1.1/-1.3	2.7/2.8
	5	-.9/-.8	11.0	8.0/7.8	10.5/10.7	1.6/1.7	-23.4/-23.1	-2.5	-31.1/-30.9	-20.4/-20.2	-18.8/-19.0	5.0	2.2/1.9	5.8
	160	.5	-3.1	-3.4	15.5/16.4	8.5/9.5	-13.9/-15.5	10.2/11.2	-18.9/-20.4	-11.3/-10.7	-8.8/-9.6	10.2/11.9	7.3/8.2	10.5/11.5
	170	.3	-.6/-.9	-1.9/-2.0	14.9/14.7	8.1	-12.9/-13.5	9.9/10.7	-16.3/-16.6	-9.0/-9.4	-9.0/-9.4	9.9/11.2	8.1	9.6/11.2
	190	0/.2	6.3/6.8	4.2	9.3	1.9/2.2	-18.4/-21.2	3.1/3.7	-27.9/-26.9	-17.0/-17.6	-15.6/-16.1	3.6/5.3	1.1/1.5	4.0/4.8
	320	-.3	6.2/6.3	4.2/3.6	9.1/10.1	3.1/3.2	-17.5/-20.3	4.9/4.8	-24.9/-27.2	-17.2/-16.7	-14.7/-15.8	5.7/6.2	2.3/2.5	5.3/5.9
1042	1	1	-9.7/-9.9	-5.9	11.9/11.8	13.2	17.2/17.3	14.8/15.0	31.8	19.6/19.7	18.1/18.3	10.8/10.7	11.9/11.8	10.7/10.8
	5	-.3	-9.9	-6/-6.2	11.9/12.2	13.4	16.8/17.0	14.5/14.3	30.7/30.8	18.6/18.8	17.5/17.3	10.2	11.3/11.1	10.2/10.3
	160	-.2	-5.2/-5.6	-2.9	8.0/8.8	8.2/9.3	12.8/14.3	9.1/10.1	24.5/26.3	15.6/14.4	13.6/14.4	5.4/7.1	6.4/9.1	5.9/7.5
	170	.2/.3	-6.5/-7.3	-4.0/-4.1	9.4	10.5/11.0	11.7/14.8	10.7/12.3	26.9/27.4	16.4/16.1	15.4/14.5	6.5/7.8	9.5/9.4	7.2/8.4
	190	.3/16	-9.1/-10.0	-6.4/-6.5	10.0/9.4	11.0/11.9	12.9/15.4	11.5/12.9	28.6/26.7	16.1/16.4	15.1/15.3	7.3/8.8	8.6/10.8	8.9/8.4
	320	0/.5	-8.7/-9.5	-6.7/-6.2	9.5/10.0	11.9/10.5	13.2/15.6	11.6/12.4	26.1/28.5	16.9/15.4	14.2/15.6	7.8/8.4	8.9/11.0	8.9/9.1

NOTES: 1) For Gage Locations See AFFDL-TR-76-8
2) Stresses In KSI

TABLE 2.1.2-XIII

UPPER LUG STRESS COMPARISONS

GAGE	COND. FLT.	BAL. ZERO LD.	F/C 14	16	20	34	51	63	88	119	122	150	166	169
2017	1	.2	15.5	14.6/14.7	-22.5/-22.7	-19.7/-20.0	19.7/20.0	-22.2/-22.5	25.8/26.0	12.8/13.0	11.4	-21.1/-21.3	-13.6/-13.8	-21.1/-21.0
	5	-.3/-.5	14.4/14.1	13.4/13.8	-21.6/-21.4	-19.4/-19.1	19.4/18.9	-22.0	25.2/25.1	12.0/12.4	10.8/10.5	-21.7/-21.9	-14.1/-14.2	-21.6
	160	.2	11.1/11.9	10.9	-6.1/-6.9	-2.3/-3.9	15.8/17.0	-4.2/-5.8	21.5/22.6	13.0/12.6	11.7/12.0	-3.9/-6.2	-.6/-2.8	-5.5/-6.6
	170	.6	10.6/11.7	10.0/10.5	-1.9/-2.5	-.6/-.8	17.7/18.6	-2.2/-3.3	24.1/24.5	14.2/14.8	13.6/13.6	-2.2/-3.3	.9/1.2	-2.2/-3.4
	190	.2/.3	13.7/14.8	12.2/13.6	-25.3/-23.6	-22.7/-21.6	16.9/18.6	-24.4/-26.2	23.7/23.4	10.2/11.2	9.2/9.5	-23.0/-29.5	-15.5/-18.1	-24.5/-24.7
	320	1.0	13.9/15.3	13.7/13.4	-25.3/-25.8	-23.9/-22.3	16.7/17.5	-25.5/-26.1	21.4/22.7	10.5/10.3	8.7/8.6	-25.0/-25.6	-17.7/-19.5	-24.4/-25.3
2018	1	-.3	16.5/16.6	15.7	-39.8/-40.1	-33.4/-33.9	31.9/32.3	38.9/39.1	39.1/39.4	20.0/20.1	17.9/18.0	-38.0/-38.2	-25.4/-25.5	-38.0/-38.3
	5	1.0	17.6/18.1	16.6/17.3	-41.6/-41.4	-34.9/-34.6	31.5/32.0	-37.8/-38.0	38.7	19.5/19.8	17.9/17.6	-37.4/-37.6	-25.1/-25.4	-38.0/-38.2
	160	-.2	18.6/20.1	18.7	-60.7/-63.0	-50.3/-55.2	26.8/28.2	-53.2/-58.5	31.3/32.2	12.5/11.8	10.2/9.3	-51.8/-58.7	-39.2/-46.4	-53.1/-57.4
	170	.2/.3	18.3/19.8	17.4/18.1	-63.9/-63.4	-56.1/-58.1	27.4/26.8	-57.3/-62.6	32.1/31.6	11.1/11.9	9.6/8.5	-55.2/-60.0	-46.0/-45.4	-54.8/-60.0
	190	0/-.3	15.3/16.7	13.5/15.3	-44.1/-41.8	-37.9/-36.8	26.0/28.6	-38.1/-41.0	34.7/33.9	15.9/17.0	14.4/14.7	-35.3/-40.2	-24.9/-28.5	-38.5/-39.3
	320	1.0	15.2/16.7	14.8/14.4	-43.2/-44.3	-39.3/-37.6	25.8/27.2	-39.7/-40.9	31.4/33.3	16.2/15.5	13.8/13.6	-38.5/-39.6	-27.7/-30.2	-37.8/-39.8
2021R	1	.9/-.2	17.0/3.6	11.7/-3.4	14.0/-47.1	14.0/-43.8	34.3/31.6	15.4/-49.0	32.1/-8.5	18.6/-6.4	16.8/-6.4	14.7/-43.5	12.6/-33.4	14.9/-43.5
	5	1/.2	16.6/2.8	15.4/2.7	15.8/-45.3	15.1/-42.3	33.6/31.3	15.3/-47.0	36.5/-7.8	18.4/-6.2	16.2/-6.3	14.2/-43	12.1/-33.1	14.4/-42.9
	160	.5/.2	15.0/.1	14.2/-.4	19.7/-33.5	18.6/-29.2	28.7/-9.4	19.7/-33.0	36.8/-10.9	20.4/-6.7	18.4/-6.4	18.6/-31.4	15.7/-25.1	18.1/-30.9
	170	.3/-.3	14.8/-.2	13.0/-.5	20.7/-30.2	20.6/-29.7	28.2/-8.2	21.3/-33.8	36.8/-10.0	21.1/-5.8	19.7/-6.0	19.4/-30.0	16.4/-22.0	19.2/-29.4
	190	.4/.1	15.5/2.5	13.1/-.1	12.2/-48.7	11.7/-46.7	30.3/33.4 -8.3	11.6/-52.1	34.6/-11.2	16.8/-9.8	15.4/10.3	9.7/-45.6	8.5/-36.2	10.3/-46.7
	320	.9/-.4	16.3/2.5	14.4/2.3	11.9/-50.5	11.2/-48.7	26.8/-9.6	11.8/-52.7	34.4/-12.5	17.4/-10.4	14.9/-11.4	10.4/-48.1	9.2/-40.2	10.2/-47.4
2022R	1	.8/-.4	17.0/3.5	15.4/3.4	8.0/-55.2	8.4/-50.9	33.9/-8.2	8.9/-56.2	44.4/-11.4	23.9/-9.2	21.3/21.6	7.4/-51.4	7.0/-39.4	7.4/-51.6
	5	.9/-.3	17.4/31.0	16.1/2.8	7.3/-55.7	7.5/-51.6	33.3/-8.4	8.7/-55.7	43.3/-11.7	23.0/-10.0	20.7/-9.9	6.8/-52.1	6.5/-40.0	6.7/-52.0
	160	.4/.1	20.8/4.9	19.2/4.2	-1.6/-67.8	-2.1/-60.9	34.4/-12.0	-1.4/-66.2	42.0/-16.8	21.6/-16.3	18.9/-17.0	-2.5/-63.6	-1.8/-52.2	-2.9/-63.0
	170	.7/0	19.6/4.7	17.6/3.9	-2.9/-67.5	-2.5/-64.6	32./-12.7	-2.1/-70.8	40.8/-17.7	20.9/-16.7	18.4/-17.1	-3.1/-65.2	-2.6/-51.0	-3.7/-64.7
	190	-.3/-1.3	15.6/2.1	13.9/1.5	7.5/-56.3	7.8/-53.2	30.4/-9.4	8.7/-56.6	40.2/-12.9	20.6/-11.0	18.7/-11.0	6.6/-51.6	6.0/-40.0	6.5/-52.8
	320	1/0	17.3/3.1	15.5/2.6	8.2/-56.0	8.2/-53.1	31.8/-9.6	9.7/-56.7	40.6/-13.3	21.5/-10.5	19.2/-10.9	7.9/-52.6	7.5/-4.3	7.2/-52.2
2031R	1	.6/-.6	2.7/-3.3	3.8/-1.2	-1.5/-15.3	1.3/-10.8	41.9/20.1	.3/-12.4	56.1/28.0	33.4/17.1	31.5/16.1	-2.6/-15.0	2.9/-5.6	-2.8/-15.0
	5	.6/0	2.7/-3.0	3.6/-.9	-3.0/-17.1	.3/-12.0	40.9/19.7	.5/-12.6	55.1/27.3	32.4/16.3	30.3/15.1	-2.7/-15.3	2.1/-6.6	-3.4/-15.9
	160	-.1/-.5	4.3/-.3	5.3/1.6	-9.6/-36.9	-6.99/-31.5	43.7/20.4	-6.4/-33.1	55.5/26.9	32.3/15.3	29.5/13.8	-9.0/-35.0	-4.3/-25.4	-9.4/-34.0
	170	.1/-.9	3.1/-1.5	3.8/.6	-8.8/-36.1	-6.0/-31.3	42.2/21.3	-5.8/-33.4	54.7/28.2	31.9/16.8	29.4/15.5	-8.4/-34.9	-3.5/-24.1	-8.6/-34.0
	190	.6/.3	4.3/-1.1	4.4/.3	-3.3/-17.1	-.7/-12.7	41.0/19.2	-.1/-13.6	53.8/26.5	32.0/15.9	30.6/15.2	-3.2/-15.4	1.5/-6.6	-3.6/-15.2
	320	.6/-.2	4.5/-1.0	4.5/-.2	-4.6/-18.2	-2.0/-14.4	40.0/18.4	-1.6/-14.9	53.3/25.4	31.8/15.1	29.6/13.8	-4.5/-16.5	-.3/-8.7	-4.5/-15.6
2032R	1	.5/0	20.9/1.3	18.3/1.2	9.0/-36.0	10.1/34.0	13.4/-10.0	8.9/-38.7	19.5/-16.1	11.5/-12.5	10.5/-12.2	7.4/-32.3	7.4/-27.0	7.7/-32.0
	5	-.3/-.6	20.7/.5	18.1/.2	8.3/-36.5	8.0/-34.5	12.0/-10.5	8.3/-38.7	18.4/-17.0	10.4/-13.7	9.1/-13.7	6.7/-33.6	6.2/-28.7	6.6/-33.4
	160	1.1	18.1/2.2	15.2/1.5	12.3/-25.4	11.8/-23.0	12.8/-15.1	12.1/-25.7	18.9/-21.0	7.0/-32.2	6.5/-32.6	7.5/-41.3	6.6/-38.3	7.5/-41.0
	170	.5/.1	20.6/1.4	16.9/.6	10.9/-22.6	11.3/-22.7	12.9/-13.5	11.5/-25.8	19.2/-19.5	11.4/-14.2	10.8/-14.5	9.3/-20.4	8.1/-17.2	8.7/-20.7
	190	3.9/.5	23.4/2.3	20.4/1.5	11.3/36.5	11.2/-35.8	14.7/1.1	11.1/-38.9	21.4/-17.1	12.4/-13.5	11.8/-14.3	8.9/-33.0	7.6/-38.0	8.5/-33.7
	320	.5/-.7	19.0/1.8	15.7/1.3	10.3/-41.0	10.1/-40.5	13.0/-13.0	10.6/-43.5	18.6/-19.6	10.9/-16.0	10.0/-17.2	8.5/-38.3	7.7/-34.9	7.9/-38.4

NOTES: 1) For Gage Locations See AFFDL-TR-76-8
2) Stresses in KSI
3) For Rosettes (R), σ Max/σ Min

However, the stress changes under load were considered to be indications that the obvious wedging caused by bushing rotation could adversely affect the fatigue life because of possible stress increases.

In order to separate the pin and bushing effects and to gather additional data, a flight (equivalent to flight 170) was run after the pins were repositioned and retained. During this flight, slightly over 200 channels of strain gage data were recorded. As expected, data from flight 170 was very similar to that from 160 indicating that pivot pin repositioning had little effect. (Ref. Tables 2.1.2-XII and 2.1.2-XIII.)

Based on the consideration of data obtained from flights 160 and 170, the bushings and spacers were returned to their nominal original positions as discussed in Section 2.2.1. Testing was then resumed.

The data recording system was partially inoperative until flight 190. During this flight, approximately 206 channels of strain gage data were recorded. Included were readings from gages installed on the lower bushing retainer system discussed in Section 2.1.1.1. A similar amount of data was obtained for flight 320 and subsequent flights through flight 1280 since RTP units were not returned during the period covered by this report.

The lug stress data from flights 190 and 320 was compared with that for flights 1, 5, 160, and 170 to determine whether restoration of the bushings and spacers to the original positions gave values similar to those for the initial flights. For the upper pivot lug, the restoration was effective with stresses tending to approach those of flights 1 and 5. For the lower pivot lug, results were mixed. Several of the gages gave readings close to those of flights 1 and 5, but others gave values essentially the same as those for flights 160 and 170. It was concluded that while rotation of the bushings and spacers predominated in causing lug stress changes, other unknown factors were present. Typical comparative data is shown in Tables 2.1.2-XII and 2.1.2-XIII. Strain gage locations are shown in Section 2.1.2.4 of AFFDL-TR-76-8 and in Figures 2.1.2-3 and 2.1.2-4 of this report.

Strain gage data for the lower bushing retainer was inconclusive since values of load indicated were low and since the apparent load direction was unexpected. It was decided that continuous strip recording of values would be obtained on later flights to determine whether higher loads occur at points other than those recorded. The strip data also showed that loads were low so no further data was recorded.

The exceedance data was reviewed and summarized for predominant gages as data for each data flight was received as a test monitoring aid.

At the end of flight 640, three additional rosette gages were added to the Y_F 992 bulkhead titanium panel at the upper outboard corner. (See Fig. 2.1.2-5.) These gages were added so that additional information for possible redesign of the panel-to-steel bulkhead segment splice could be obtained. Readings were obtained for flights 800, 960, 1120 and 1280. Typical average values for flight 800 along with comparative values for the math model are shown in Table 2.1.2-XIV. Since gages 4029 and 4030 back up each other, the direction of the maximum stress for 4030 appeared to be in error considering 4029 and 4032 and the general math model stress direction. Consequently, results from 4030 were not used in later analysis.

At the end of flight 1280, three additional rosette gages were added to the Y_F 992 bulkhead titanium panel at the lower outboard corner to obtain additional information on stress distributions in the vicinity of a failed Taper-lok fastener. (See Fig. 2.1.2-6.)

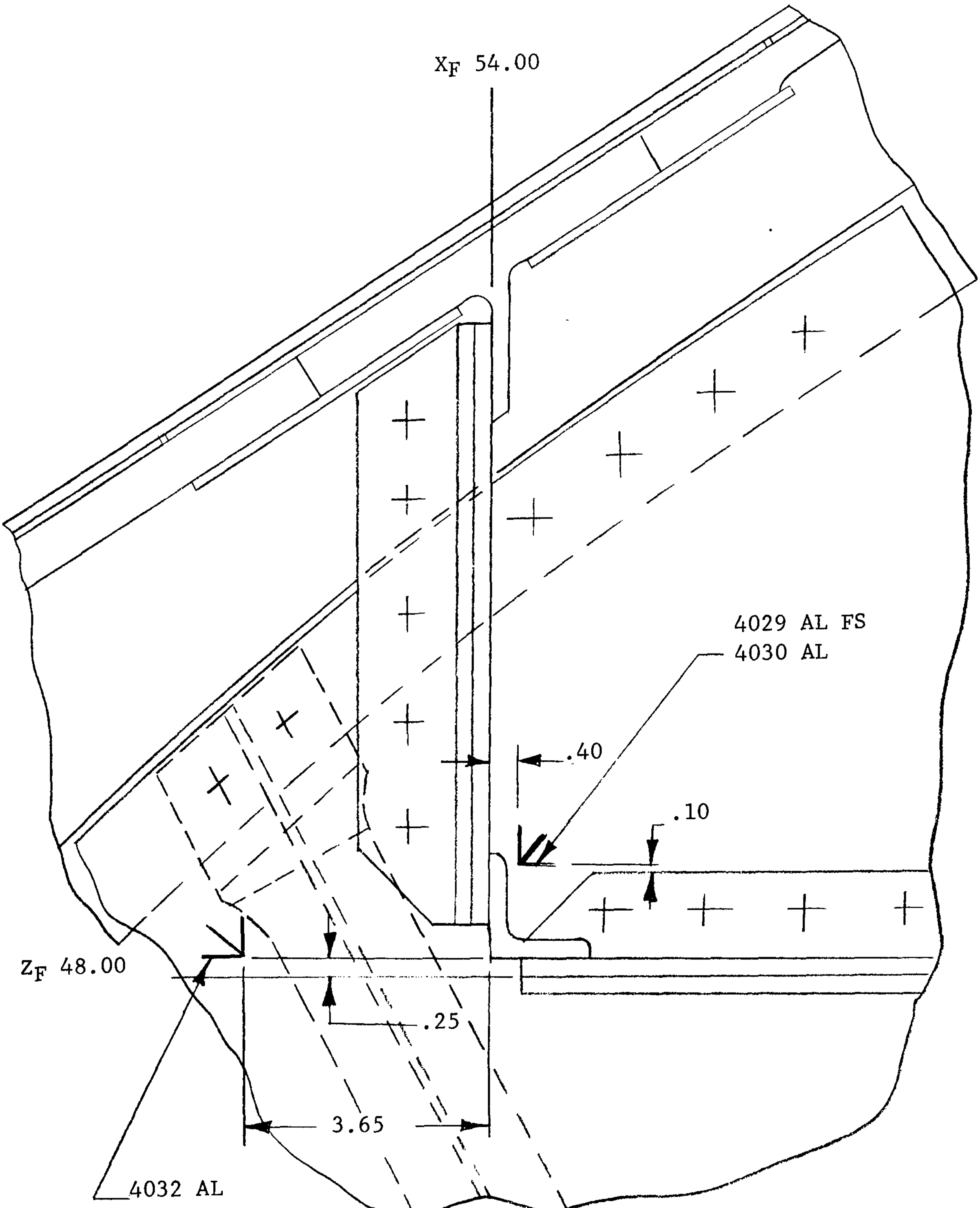
During the course of the testing, significant changes occurred in several gage outputs in addition to those influenced by the bushing and spacer rotations discussed previously. Most of these changes resulted from damaged or faulty gages, gage installations, or connections. Some changes, however, remain unexplained, e.g. gages 1122 SL and 1108 SL on the Y_F 947 beam and lower titanium panel respectively. Both of these gages have exhibited progressive decreases in readings. (See Table 2.1.2-XV.) Physical examination of the areas has revealed no structural damage so continued monitoring is planned rather than gage replacement for the time being. It may be noted that the readings have tended to stabilize.

2.1.2.7 Stress Analysis Related to Full Scale Testing

Stress analyses related to problems described below were accomplished to support the Full Scale Test. Specific details of the problems along with related drawings are included in Section 2.2.1.

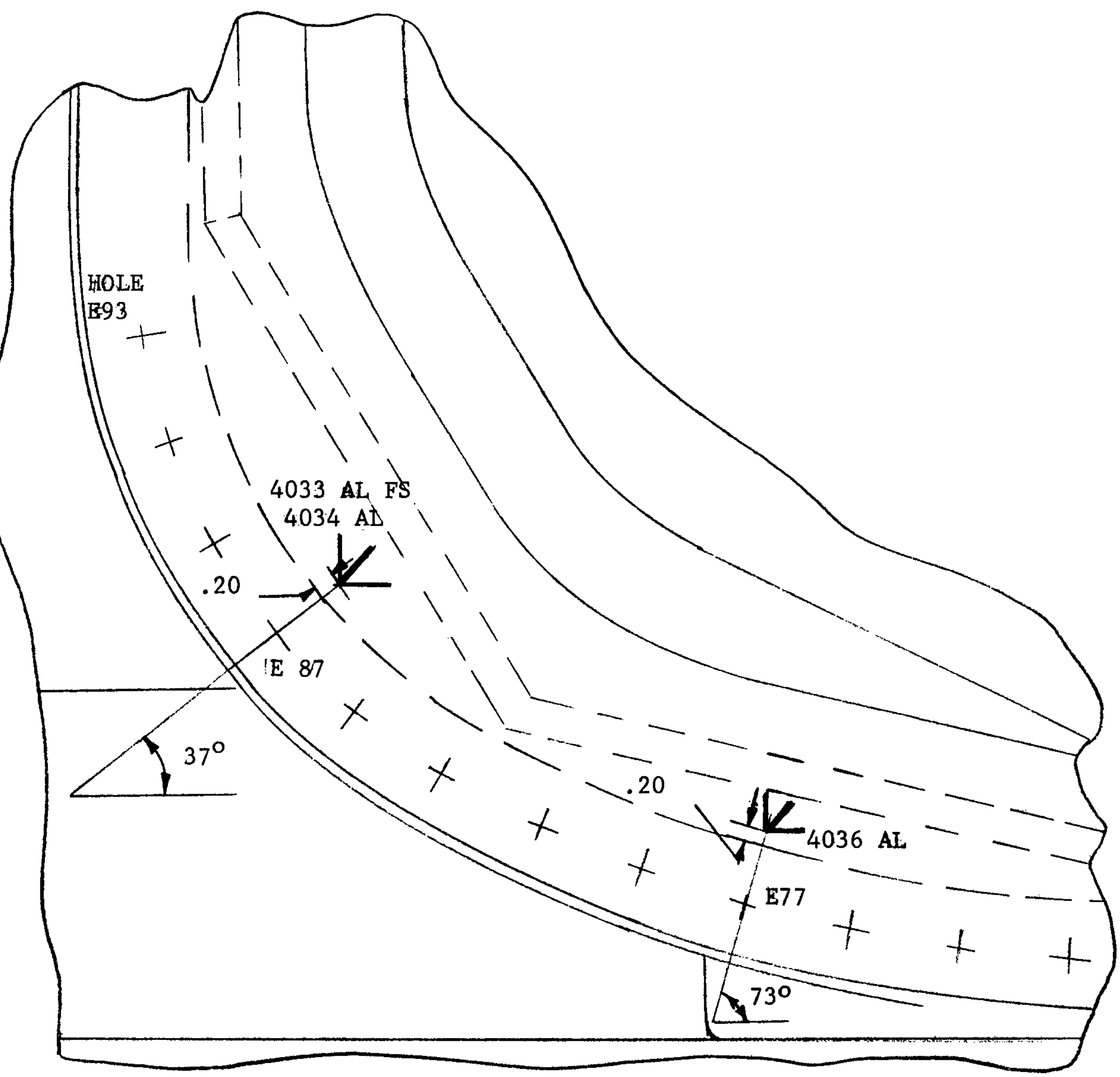
Rotation of Pivot Pins, Bushings, and Spacers

The pivot pins, bushings, and tapered spacers rotated out of position during the first 160 flights. Stress analysis of the tools and tool attachments necessary to return the parts to their nominal original position was accomplished. In addition, assistance was provided in sizing the various restraining devices installed to prevent rotational movements of the pins and bushings for subsequent testing. In general, design loads for the retaining devices were based on torques found necessary to restore the components to their original positions.



VIEW LOOKING FWD
FIGURE 2.1.2-5

ADDED STRAIN GAGES - Y_F 992 BULKHEAD
UPPER OUTBOARD PANEL REGION



VIEW LOOKING FORWARD

FIGURE 2.1.2-6

ADDED STRAIN GAGES - Y_F 992 BULKHEAD
LOWER OUTBOARD PANEL REGION

GAGE/FATIGUE COND.	20				63				150			
	TEST		MODEL (1)		TEST		MODEL		TEST		MODEL	
	σ Max	σ Min	σ Max	σ Min	σ Max	σ Min	σ Max	σ Min	σ Max	σ Min	σ Max	σ Min
4029 SL	13.9	-25.2	3.9	-26.1	14.7	-27.6	3.9	-27.2	12.7	-24.3	3.4	-24.2
4030 SL	7.0	-25.5	3.9	-26.1	7.3	-27.8	3.9	-27.2	6.6	-23.9	3.4	-24.2
4032 SL	4.5	-23.3	3.6	-37.1	4.9	-25.2	3.4	-38.8	4.3	-22.0	3.2	-34.7

NOTES: (1) Element 1219 for 4029 & 4030. EL. 1242 For 4032
(2) Stress in KSI
(3) Data Flight 800

TABLE 2.1.2-XIV

TYPICAL STRAIN GAGE DATA FOR ADDED Y_F 992 BULKHEAD GAGES WITH COMPARATIVE DATA FROM NBB 5 MODEL

TABLE 2.1.2-XV

COMPARATIVE STRAIN GAGE RESULTS

GAGE 1108

FLIGHT / FATIGUE CONDITION	BALANCE	14	20	63	150	ZERO
640	-.2	-.7	12.1	11.6/12.9	9.9/10.4	-.5
800	-.1	-1.6	8.4/9.2	8.4/9.4	6.8/7.5	-.5
960	.1	-2.6	6.2/6.6	6.2/6.9	4.8/5.4	-.3
1280	-.8	-2.5	5.7/6.2	6.3	4.9	.1

GAGE 1122

FLIGHT / FATIGUE CONDITION	BALANCE	14	20	63	150	ZERO
640	-.5	-8.1	22.4/22.7	22/24.6	18.6/19.6	-.4
800	0	-5.6	16.8/18.7	17.5/19.7	14.3/15.8	-.1
960	-.3	-5.8	16.9/18.2	17.5/19.5	13.8/15.4	-.3
1280	.3	-5.2	17.7/18.7	19.4	15.5	.3

NOTES: Stress in KSI

Bolt Failures, Y_F 932 Bulkhead, X_F 84 Rib

Several shear failures of the .375 inch bolts which attach the bulkhead to the rib occurred. The loading is complex because of the multiplicity of parts being joined; i.e. gussets, titanium panels, steel bulkheads segment, aluminum rib, and bulkhead cap kick load fitting. The design analysis showed a positive margin of safety at ultimate load based on consideration of probable inelastic load redistribution at high static load levels. It appears that the failed fasteners were carrying a higher percentage of the joint load during fatigue cycling since little inelastic redistribution takes place at fatigue load levels. As noted in Section 2.1.1.2, the fasteners were increased to one-half and seven-sixteenth inch diameter following one life of testing. (1280 flights)

Hi-lok Head Failures, Y_F 932 Bulkhead

At flight 1269, several broken/cracked Hi-lok heads in the pattern attaching the aluminum bulkhead panel to the X_F 39 rib were noted. Analysis indicated that joint loads were within the rated shear strength of the fasteners, but prying arising from the single shear arrangement apparently overloaded the heads resulting in cyclic failures. As noted in Section 2.2.1, these fasteners were replaced with shear bolts for increased head strength following one life of testing.

Taper-lok Failure, Y_F 932 Bulkhead

At flight 802, a Taper-lok (C-84) in the lower outboard corner of the Y_F 932 bulkhead titanium panel was found to have failed in the threads. The predominant factor in the failure is believed to be bolt prying caused by the single shear arrangement. However, calculated margins of safety for ultimate load are negative for the following reasons:

1. The drawing sign out analysis was based on a math model which preceded the final computer run. The earlier model gave loads less than those from the final model.

2. The sign out analysis did not adequately consider increased bolt loads resulting as the pattern changes direction from horizontal to vertical.

3. The measured stresses based on the single pertinent strain gage in the region (3005 SL) are higher than those predicted by the final math model.

Following 1280 flights (1 life) the adjacent fastener (C-86) was removed because of uncertainties arising from a loose nut. The Taper-lok was intact, but some indications of working in the hole were observed (galling or fretting).

Taper-lok Failure, Y_F 992 Bulkhead

At flight 1209, Taper-lok E-87 at the lower outboard corner of the Y_F 992 bulkhead was found to be failed in the threads. Bolt prying caused by the single shear joints appear to have occurred. Further review of the area showed that for the current math model loads, negative fastener shear margins exist for static ultimate load. It was decided that several rosette strain gages would be added in order to obtain additional stress distribution data. (See Fig. 2.1.2-6 for gage locations.)

Bolt Failures, Y_F 992 Bulkhead

As early as flight 320, loose bolts were discovered in the pattern attaching the titanium panel to the steel bulkhead in the upper outboard corner region. Subsequently, as discussed in Section 2.2.1, several fastener failures occurred as well as repeated loosening. Undoubtedly, fastener prying resulting from the single shear arrangement was the primary cause of fastener failure, but review of the analysis revealed negative margins for fastener shear at ultimate load using the current math model. The fastener loads used for design were based on a model which did not reflect final panel stiffnesses and hence the loads were underestimated. Strain gages were added to obtain additional information as noted in Section 2.1.2.6. It was decided that the fastener pattern would be changed at one life (1280 flights) to give increased strength as discussed in Section 2.2.1. This change resulted in calculated negative margins of safety in net shear on the steel bulkhead for static ultimate load based on strain gage results and math model data. However, fastener margins became positive.

When the fasteners were removed for rework, cracks were found in several holes. The cracks were removed when the holes were enlarged to accommodate the redesign or by special hole diameter increases or countersinks as discussed in Section 2.2.1.

Y_F 992 Access Door Attachment

Because of repeated loosening of the fasteners attaching the primary access doors to the Y_F 992 bulkhead, longer bolts compatible with the locking feature of the nutplates became desirable. (Ref. Section 2.1.1.2.) Since the desired bolts had lower shear strength than those on the original design, analysis was conducted to assure that sufficant strength was retained. The analysis was conservatively based on the math model which does not reflect load reduction resulting from the oversized holes specified on the drawing.

Simulated Fuselage Failures

Simulated fuselage failures have fallen into two broad categories: (1) fastener failures, and (2) cracks in skins, webs, and attach angles.

The fastener failures have occurred primarily because spanwise loads transferred to the simulated fuselage from the WCTS through the fastener patterns were not adequately predicted by the relatively coarse grid math models used as a basis for simulated fuselage analysis.

In most cases the cracks have occurred where bending of relatively thin members has been produced by relative motion between two stiff load paths connected by the thin members.

Thus far, the failures have occurred in easily repaired areas or in areas where the secondary nature of the structure has made immediate repair unnecessary.

2.1.2.8 Lower Test Fixture Deflection Effects Study

Predicted deflections and wing pivot loads presented in the Full Scale Test Program Test Plan, FZS-219, Rev. B, are based on the assumption that points on the upper test fixture at Y_F 550 and Y_F 1400 have zero vertical motion relative to the test floor. Measured deflections are of two types: 1) deflection between the upper test fixture and the lower test fixture, and 2) deflection between the lower test fixture and the test floor. For meaningful comparisons between predicted and test data, adjusted deflections relative to the assumed baseline must be obtained from the measured data. It was determined that the largest single effect was nose up pitching of the upper test fixture resulting from significant vertical deflection of the forward end of the lower test fixture relative to the test floor.

Equations were developed to obtain first order corrected deflections for use in obtaining effects on pivot loads of sweep actuator reaction arm angle variations caused by deflections. For those conditions checked thus far, the effects were small.

2.1.3 Fatigue and Fracture Analysis

The updated loads stress data received on tape from the UGO stress model runs was screened for elements which had stresses exceeding the levels of Section 4.3.1 of FZS-219 Rev. B dated 30 April 1975. The locations with stresses exceeding the screening levels compared favorably with those used to develop the fatigue and fracture analysis results published in FZS-219. Based on these levels and subsequent analyses using stresses from the math model, strain gage results, and hand calculated stresses for the updated loads, the six control points shown in FZS-219, Rev. B were retained.

Fatigue and fracture analyses for the six control points have been substantially completed. The results are being reviewed. Preliminary indications are that adequate fatigue life (one life SF=4.0) and crack growth life (1280 flights) exist for each of the control points.

Additional analysis will be accomplished where dictated by full scale test results.

Final documentation of results of the fatigue and fracture analysis will be included in the next revision of FZS-219.

2.1.4 Information Transfer

During the reporting period, the Fifth Interim Report, AFFDL-TR-76-8, was submitted for AFFDL review. Following minor revision to reflect review comments, it was then resubmitted to AFFDL for Air Force publication and distribution.

Supplement 1 to FZM-6148B, Material Property Data Test Report, was submitted to AFFDL. This supplement incorporated credible option data that was available through October 1975.

2.2 TESTING

Full scale testing and material testing activities during this reporting period are described in this section.

2.2.1 Full Scale Test

During this reporting period, the first life of fatigue testing - 1280 flights - along with the associated data recording and inspections was completed. Table 2.2.1-I summarizes the significant problems encountered in the WCTS and test structure. More detailed discussion of these problems will be found below in 2.2.1.1, presented essentially on a chronological basis. Strain gage results are discussed in Section 2.1.2.6. Table 2.2.1-II shows the regular inspection intervals and types. Additional inspections in local areas were made as required.

Several of the failed fasteners were examined in the Metallurgy laboratory at General Dynamics/Fort Worth. The results are summarized in Table 2.2.1-III. For all of the fasteners examined, fatigue was the cause of failure.

Fastener hole identification drawings were prepared to provide a common base for discussions. These drawings are included at the end of this section as Figures 2.2.1-4 through 2.2.1-14.

Early in the first fatigue life, analysis of fastener problems indicated certain negative margin design areas. At that time, a joint AFFDL/General Dynamics test philosophy was adopted to protect the schedule position of the program. This philosophy, or test approach, was to defer incorporation of any required design changes in the WCTS until the end of the first service life. This approach reflected the feeling that most problem areas would be revealed in the first service life and that test schedules should be maintained, if possible, without downtime for incorporation of changes, so that problem areas could be defined at the earliest possible time. Consistent with this goal, a "replace and continue" approach (in the case of fastener failures) was generally followed during the first service life of testing.

2.2.1.1 First Service Life

Fatigue testing was initiated on 21 October 1975 utilizing the Full Scale Test Set-Up shown in Figure 2.2.1-1. Except for test system problems, which were expected for a complex system, testing was essentially uneventful for the first one-eighth service life (160 flights).

When the first 160 flights of the testing were completed, the scheduled Category II visual inspection was accomplished. Numerous fasteners were found to be loose in the Y_F 992 bulkhead access panels and in the simulated fuselage structure, especially from Y_F 992 to Y_F 1050. These fasteners were all retorqued.

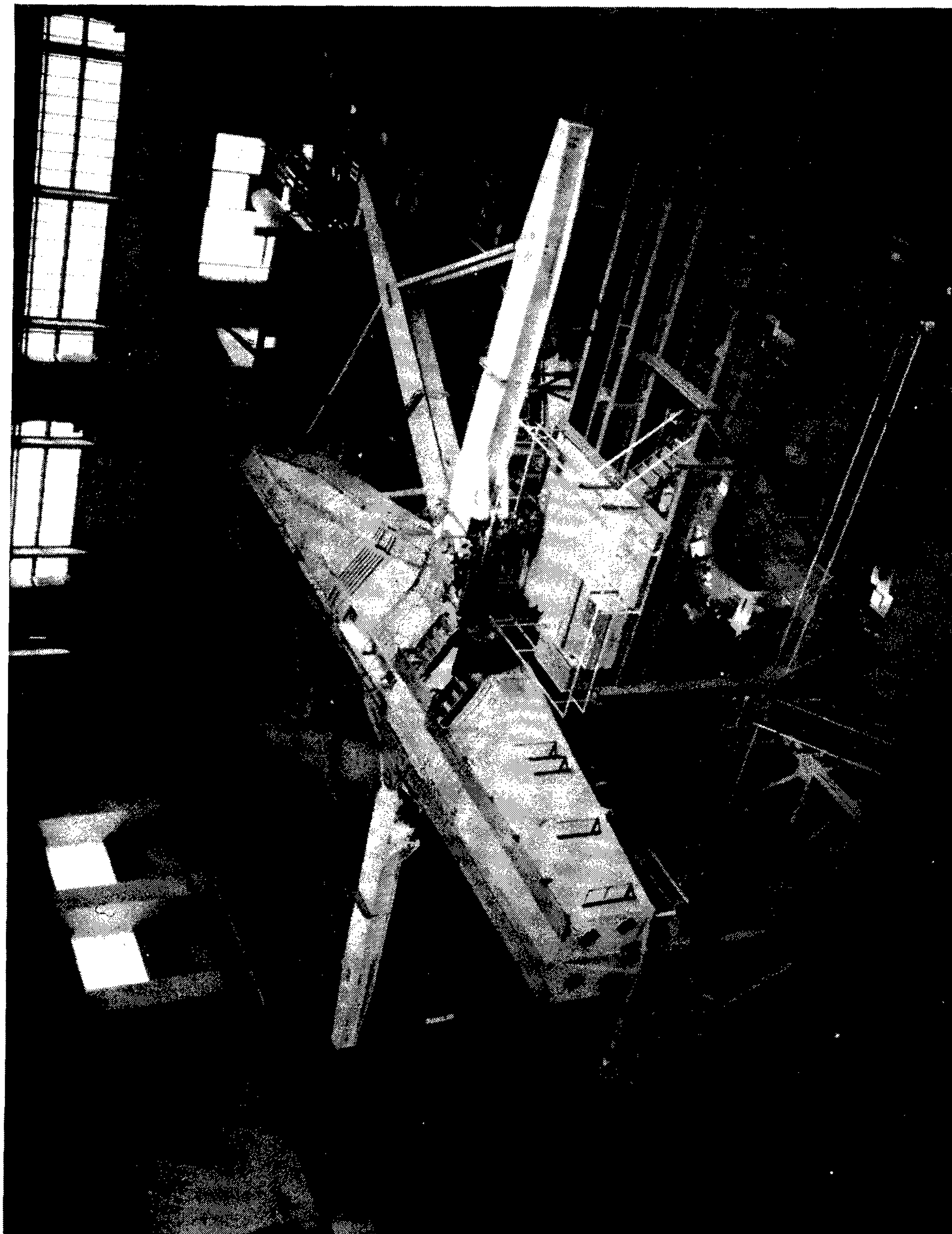


FIGURE 2.2.1-1
FULL SCALE TEST SET-UP

TABLE 2.2.1-I

FULL SCALE TEST-PROBLEM SUMMARY

FLIGHT	WCTS	TEST FIXTURE STRUCT.	PROBLEM DESCRIPTION	GENERAL LOCATION	FASTENER HOLE NO.	CORRECTIVE ACTION/COMMENTS
117		X	Shifting of MLG trunnion pins	MLG		Repositioned and re-tightened.
157		X	Shifting of MLG trunnion pins	MLG		Installed shim to preclude movement.
160		X	Loose fasteners	Simulated fuselage - Y_F992 to Y_F1050		Retorqued fasteners.
	X		Loose fasteners	Y_F992 access panel		Retorqued fasteners.
		X	MLG trunnion	MLG		No additional shifting-but installed clamp as positive restraint.
		X	Rotation of pivot pins, bushings and spacers.	Wing pivot		Realigned and restrained.
320	X		Loose fasteners	Y_F992, X7224061 attachment	E811,813,821,837,839,841, 845,847,849,851,853,855, 859,863,802,804,806,810, 812,822,830,832, 838,840, 846,850,852,854,856,858	Retorqued fasteners.
	X		Loose fasteners	RH closure rib to Y_F992 bulkhead	E262,264,266,268	Retorqued fasteners.
	X		Loose fasteners	Upper fwd corner of closure rib.	B75, 76	Retorqued fasteners.
	X		Evidence of relative motion	Between closure ribs and bulkheads		No fretting observed.
		X	Broken bolt	Lwr. skin of fwd simulated fuselage to outbd longeron		Replaced with next larger diameter.
		X	Minor repositioning of pivot pins, bushings, and spacers.	Wing pivot		Considered to be natural "seating" - no action required.
422		X	Failed Hi-lok head	Upper skin - simulated fuselage		Replaced with shear bolt after flight 442.

TABLE 2.2.1-I (CONTINUED)
FULL SCALE TEST-PROBLEM SUMMARY

FLIGHT	WCTS	TEST FIXTURE STRUCT.	PROBLEM DESCRIPTION	GENERAL LOCATION	FASTENER HOLE NO.	CORRECTIVE ACTION/COMMENTS
		X	Doubler buckling	Upper skin-simulated fuse. LH		Secondary structure - no action.
442		X	Failed Hi-lok at thread	Upper skin-simulated fuse.		Same Hi-lok as one found after flight 442.
	X		Bolt failure - shear	X_F84 rib, Y_F932 bhd.	C756	Replaced W/O nut at flt. 447. Nut added at end of flt. 480. Replaced with new fastener after flt. 640.
480	X		Loose fasteners	Y_F992, X7224061 attachment	Not recorded	Applied loc-tite and retorqued.
	X		Bolt failure-at head	Y_F992, X7224061 attachment	E872	Installed temporary bolt, C-081-6. Replaced with proper bolt after flight 640.
		X	Crack in buckled doubler	Upr. skin-simulated fuse. LH		Added field fasteners.
481		X	Bolts broken in threads	Upr. bushing retention system - 3 aft LH, 1 aft RH		Failed bolts inserted with retention for temporary fix. Repaired (new bolts) after flt. 640
562	X		Bolts broken in threads	Y_F992, X7224061 attachment	E860, 864	Installed temporary C081-6 bolts. Replaced with proper bolts after flt. 640.
569	X		Bolt failure-shear	X_F84 rib, Y_F932 bhd.	C755	Installed temporary bolt, C081-6. Replaced with proper bolt after flight 640.
640		X	Hi-lok failures (2)	LH, upr skin-simulated fuse. to outboard longeron.		Replaced 4 bolts in each pattern/side with 300 KSI heat treat bolts.
		X	Interference between MLG trunnion pin and WCTS lwr. plate	Left side		Nut ground off-no damage to WCTS.
		X	Wing sweep actuator-hyd. cylinder rod end-damaged threads			Discovered after removal of in-operative load cell. Repaired cylinder with modified rod from spare actuator.
	X		Preventive maintenance	Y_F992, X7224061 attachment	E841-878	Replaced with new bolts installed with retaining compound.

TABLE 2.2.1-I (CONTINUED)

FULL SCALE TEST-PROBLEM SUMMARY

FLIGHT	WCTS	TEST FIXTURE STRUCT.	PROBLEM DESCRIPTION	GENERAL LOCATION	FASTENER HOLE NO.	CORRECTIVE ACTION/COMMENTS
640 (Contd)	X		Preventive maintenance	Y_F992, X7224061 attachment	E2025-2028	Replaced titanium Hi-loks with 260 KSI heat treat bolts installed with retaining compound.
	X		Preventive maintenance	X_F84, Y_F932	C751, 752	Replaced with original design bolts
	X		Preventive maintenance	Y_F992 access panels		Replaced C081 bolts with NAS674 bolts to provide proper engagement with nut plates. Replaced formed-in-place gasket.
		X	Preventive maintenance	Upr. RH doubler-Simulated fuselage		Added 3 field bolts
		X	Preventive maintenance	Upr bushing retention system bolts.		Replaced 3 broken bolts on LH side. Could not remove RH bolt (1) because of removal tool breakage.
802	X		Taper-lok failure-thread	Y_F932,X7224083 attachment	C84	Reworked hole-installed oversize Taper-lok.
876	X		Bolt failure-shear	X_F84 rib, Y_F932 bhd.	C756	Second failure-replaced without nut.
936		X	Bolt failure	Aft centerline fuse @992 lwr		Replaced with new bolt.
957		X	Pivot bar of W-2 ram broken.	LH wing		Replaced
960	X		Loose fasteners	Y_F932, upr. corner, inbd of X_F84	C293,295,315,317,341, 294,296,752,127	Retorqued fasteners.
		X	Bolt failure	Fwd. simulated fuse., lwr. skin to outbd. longeron		Replaced with new fastener.
1036	X		Cracked attach angles	Fairing attach beam, Y_F932 at X_F84		Cracks in X7224169-13/-14. Secondary structure - no action.
1209	X		Taper-lok failure-thread	Y_F992,X7224061 attachment	E87	Replaced on temporary basis with same size fastener. Hole reworked and oversize fastener installed after flight 1280.

TABLE 2.2.1-I (CONTINUED)

FULL SCALE TEST-PROBLEM SUMMARY

FLIGHT	WCTS	TEST FIXTURE STRUCT.	PROBLEM DESCRIPTION	GENERAL LOCATION	FASTENER HOLE NO.	CORRECTIVE ACTION/COMMENTS
1269	X		Cracked/broken Hi-lok heads	X_F932, X_F39 rib attachment	C424,432,436,438,421,425, 429.	Replaced with shear bolts after flight 1280.
1280	X		Cracks in 10 Nickel Steel	Upr. portion Y_F992 bhd. in X7224061 attachment pattern	E843,847,851,863,842,846, 850,852,856,860	Increased hole size and chamfers to remove cracks.
	X		Loose nut on Taper-lok	Y_F932, X7224083 attachment	C86	Reworked hole-replaced with over-size Taper-lok.
		X	Cracked web	X7224166 simulated fuse. skin attachment support, X_F99		Stop drilled-inbd and outbd.
		X	Strap working	Lwr LH bushing retention strap to collar attachment.		Minor working - no action.
	X		Taper-lok, gap under head	Y_F932 at X_F39 rib	C116	Added washer under nut and re-torqued to properly seat head.
	X		Broken bolt	Y_F932, X_F84 rib attachment	C755	Second failure - replaced with larger fastener as part of 1st life modification.
		X	Broken Hi-lok	Fwd. simulated fuse. upper skin attachment angle to outbd longeron		Replaced with new bolt and chamfered washer

Table 2.2.1-II

SUMMARY OF INSPECTION TASKS BY CATEGORY
FATIGUE TEST PROGRAM

TYPE INSPECTION	INSPECTION CATEGORY				
	I	II	III	IV	V
VISUAL	X	X	X	X	X
MAGNETIC RUBBER			X	X	X
PENETRANT				X	X
ULTRASONIC			X	X	X
RADIOGRAPHIC					X
MAGNETIC PARTICLE					X
AUTO EDDY CURRENT					X
INSPECTION @ FLIGHTS NOS. FOR EACH 1280-FLT	DAILY	160 480 800 1120	**320 640 **960	TEST START* 1280	SPECIAL/ INVESTIG. AS REQ'D

*BASELINE INSPECTION @ TEST START

**THESE CATEGORY III INSPECTIONS ARE REDUCED TO CATEGORY II FOR LIVES 2, 3, AND 4.

Table 2.2.1-III

Fracture Analysis of Failed Bolts from AMAVS Fatigue Test

Failure No.	Location	Flt #	Fastener	Fracture Origin	Probable Cause
1	Most aft (2) bolts attaching fwd. fuse lower skin to FTB116 longeron	320	220-4A	1 large fatigue origin in center of shank, .19"l x .1"d, additional crack in shank	Bolt bending
			220-4A	1 large, multi-level crack in center of shank, .11"l x .12"d, several additional cracks in shank	Bolt bending
2	Most aft Hi-Lok attaching upper skin of fwd. fuse to FTB301-63 splice angle (RH) to FTB115 longeron	427	HL 814	4 fatigue origins in flange head; 1 origin in 2nd thd. root - .15"l x .015"d	Tensile loading of head and threads
3	XF84 Rib @ YF932 BHD - hole C756	442	C4550-6-26	1 multi-level fatigue origin in center of shank, .14"l x .035"d	Bolt bending
4	4061 panel to 992 BHD - in line with 4159 beam hole E872	480	C4550-6	1 fatigue origin in shank at head radius, .2"l x .02"d	Tensile loading of bolt head
5	4061 panel to 992 BHD, hole E860	562	C4550-6	1 fatigue origin in root 1st thd., .19"l x .017"d	Tensile loading of thread
6	XF84 Rib @ YF932 BHD, hole C755	569	C4550-6	1 fatigue origin, .075"l x .03"d center of shank	Bolt bending
7	Upper skin of fwd (RH) fuselage to FTB301-63 splice	640	HL 814	2 fatigue origins in flange head of bolt @ radius	Tensile loading of head
			HL 814	2 fatigue origins in flange head of bolt @ radius	Tensile loading of head
8	Attachment pattern X7224083 titanium panel to YF932 BHD Hole C84.	802	2TLC21-8	1 small fatigue crack in 1st thd. root .4"l x .01"d 90° of circumference	Tensile loading of thread

In addition to the loose fasteners, rotations of wing pivot pins, bushings, and spacers were found to have occurred. The estimated rotations and associated gaps are summarized in Table 2.2.1-IV. The pin rotations were terminated by contact of the shear strut eye-bolts (Dwg. 603FTB023) with the clearance holes in the dummy wings. Because of the shear strut misalignment caused by the pivot pin rotations, it was decided that the pins would be rotated back to their nominal position and this was accomplished on 3-4 December 1975. The pin preload collars were then reinstalled. Pertinent data is summarized in Table 2.2.1-IV. No bushing or spacer rotation occurred during the pin rotation operations.

After a review of the lug geometry changes that appeared to be necessary to accommodate the bushing and spacer rotations, and of the strain gage data taken during flights 1, 5, and 160, it was decided that adverse stresses could result in the pivot lugs although the magnitude could not be established accurately with the information on hand. (Ref. Section 2.1.2.6.) Consequently, plans were made to obtain additional strain gage data and to design and manufacture tools for rotating the lug bushings back to their correct position and retainers to prevent bushing rotations in the future. In addition, fittings were designed, built, and installed to prevent appreciable relative motion between the dummy wing and shear strut eyebolts so that pivot pin rotations are limited by the dummy wing.

Prior to running flight "170", which was chosen as a repeat of 160, measurements of the positions of the installed pins, spacers, and bushings were made. The pertinent values are shown in Table 2.2.1-IV. Flight "170" was then run and transducer data was obtained. Finally, the positions of the pins, bushings, and spacers were rechecked. The results are shown in Table 2.2.1-IV. No significant strain differences between flights 160 and "170" were observed. (Ref. Section 2.1.2.6) The test was "quiet" indicating that retorquing of the loose bolts had reduced the noise level. Some relative rotational motion between the dummy wing and WCTS lugs about the pivot pin axis was measured on the left side wing using a deflection transducer installed for flight "170".

A lower bushing rotating tool was designed and manufactured. As noted in Table 2.2.1-IV, both lower bushings were successfully returned to the nominal locations (December 16).

A repair team from GD/FW arrived at WPAFB on 5 January 1975 and accomplished the following tasks during the week of 5-10 January.

TABLE 2.2.1-IV

AMAVS PIN, BUSHING, SPACER DATA

	AFTER FLT. 160 W/ PRELOAD	AFTER FLT. 160 W/O PRELOAD	AFTER PIVOT PIN ROTATION W/O	AFTER PIVOT PIN ROTATION W/	AFTER FLT 170 W/	AFTER FLT 170 W/O	AFTER LOWER BUSHING ROTATION	AFTER UPPER BUSHING ROTATION	AFTER SPACER ROTATIONS	PRIOR TO FLT.161	AFTER FLT 320
LEFT HAND SIDE											
Pin Rotation	1.18CW	0	1.12CCW	0	0	0	0	0	0	0	1/16"CW
Upper Bushing Rotation	3.10CCW	0	0	0	0	0	0	3.06 CW	0	0	1/16"CW
Upper Spacer Rotation	3.0 CCW	0	0	0	.160CW	0	0	-	3.0 CW	0	1/16"CW
Gap Between Bushing & Pin Head	.073/11:00	.073/11:00	.235/11:00	.072/11:00	.067/11:00	.080/11:00	.098/11:00	.020/1:30	NM	**	0
Gap Between Upper Spacer & Lug	NM	NM	NM	0	.020/10:00			.20/2:00	NM	**	0
Gap Between Upper Bushing & Lug	0	0	0	0	0	0	0	.053/5:00	NM	0	0
Gap Between Lower Spacers & Lower Lug	NM	NM	NM	0	0	NM	.050	N/M	NM	**	0
Lower Spacer Rotation	1.50CW	0	0	0	0	0	0	-	1.50CCW	0	5/8" CW
Lower Bushing Rotation	1.55CW	0	0	0	0	0	1.55CCW	0	0	0	1/16"CCW
Torque to Return Upper Bushing (In. KIPS)	-	-	-	-	-	-	-	542	-	-	-
Torque to Return Lower Bushing (In. KIPS)	-	-	-	-	-	-	353/258*	-	-	-	PRELOAD BOLTS & TOOL PROVIDED RESISTANCE.
Torque to Return Pivot Pin (In. KIPS)	-	-	392	-	-	-	-	-	-	-	-
Nominal Pin Preload Value (KIPS)	15	0	0	30	30	0	0	0	0	30	-
Gap, Lower Bushing Head to Lug	0	0	0	0	0	0	.011/8:00	NM	NM	**	0
RIGHT HAND SIDE											
Pin Rotation	1.10CCW	0	1.10CW	0	.050CCW	0	0	0	0	0	1/8"CCW
Upper Bushing Rotation	.92CW	0	0	0	.050CCW	0	0	.93 CCW	0	0	1/8"CCW
Upper Spacer Rotation	.85CW	0	0	0	0	0	0	--	.85 CCW	0	1/4"CCW
Gap Between Bushing & Pin Head	.032/1:30	.032	.062	.024	.007/1:30	.007	.004/1:30	.009/2:00	NM	**	0
Gap Between Upper Spacer & Lug	NM	NM	NM	0	<.005	NM	NM	.067/7:30	NM	**	0
Gap Between Upper Bushing & Lug	0	0	0	0	0	0	0	.017/5:00	NM	**	0
Gap Between Lower Spacer & Lower Lug	NM	NM	NM	0	0	NM	.060	.07	NM	**	0
Lower Spacer Rotation	1.6 CCW	0	0	0	0	0	.090CW	-	1.6 CW	0	3/8"CCW
Lower Bushing Rotation	2.55CCW	0	0	0	0	0	2.45CW	0	0	0	0
Torque to Return Upper Bushing	-	-	-	-	-	-	-	237	-	-	-
Torque to Return Lower Bushing	-	-	-	-	-	-	408	-	-	-	-
Torque to Return Pivot Pin	-	-	336	-	-	-	-	-	-	-	-
Nominal Pin Preload Value	15	0	0	30	30	0	0	0	0	30	-
Gap, Lower Bushing Head to Lug	0	0	0	0	0	0	.020	.020/1:30	NM	**	0

NOTES: Clockwise & CCW Looking Down. Rotations are Measured from Previous Known Location.

Rotations are Relative Motions at Tangent Points on Outermost Periphery - Expressed in Inches. Gaps Measured in Inches.

NM = NOT MEASURED

* First Value was Initial Value to Move Beyond Required Location, Second Value is to Back Off to Correct Location.

** Measurement of gaps, if any, attempted with .005 inch gage - All gaps less than .005 inch.

- Installation of the wrenching mechanism required to realign the upper bushings

- Installation of the upper bushing retention systems following their rotation by the WPAFB Test Lab personnel

- Installation of the lower bushing retention systems

- Realignment of all of the tapered spacers between the WCTS and wing lugs except for the upper left hand spacer (accomplished later by WPAFB Test Lab personnel).

The condition of the pin systems following the upper bushing rotations is documented in Table 2.2.1-IV. Also shown is the condition of the system after application of the pivot pin preload, prior to test resumption. Photographs of the bushing retention systems are presented in Figures 2.2.1-2 and 2.2.1-3.

Resumption of full scale fatigue testing, following the down time required for restoration and retention of the pivot system, was attempted 15 January. Due to a malfunction in one of the hydraulic servo valves, testing was delayed. The valve was repaired and fatigue testing was resumed 19 January. The first one-quarter life (320 flights) was completed 29 January. Testing was then discontinued to conduct the first scheduled Category III inspection.

This first major inspection utilized visual, ultrasonic, and magnetic rubber techniques, and necessitated the removal of four panels for access to the interior of the WCTS and the aft simulated fuselage. The inspection was conducted between 30 January and 5 February.

The visual inspection consisted of a thorough observation for the presence of adverse conditions in all external and internal areas of the WCTS, and the interface areas of the simulated fuselage. Primary items looked for were cracks, loose fasteners, broken fasteners, and delamination of bonded panel edge members.

During the course of this visual inspection, the following conditions were observed:

- 31 loose fasteners attaching the X7224061 panels to the Y_F 992 bulkhead.

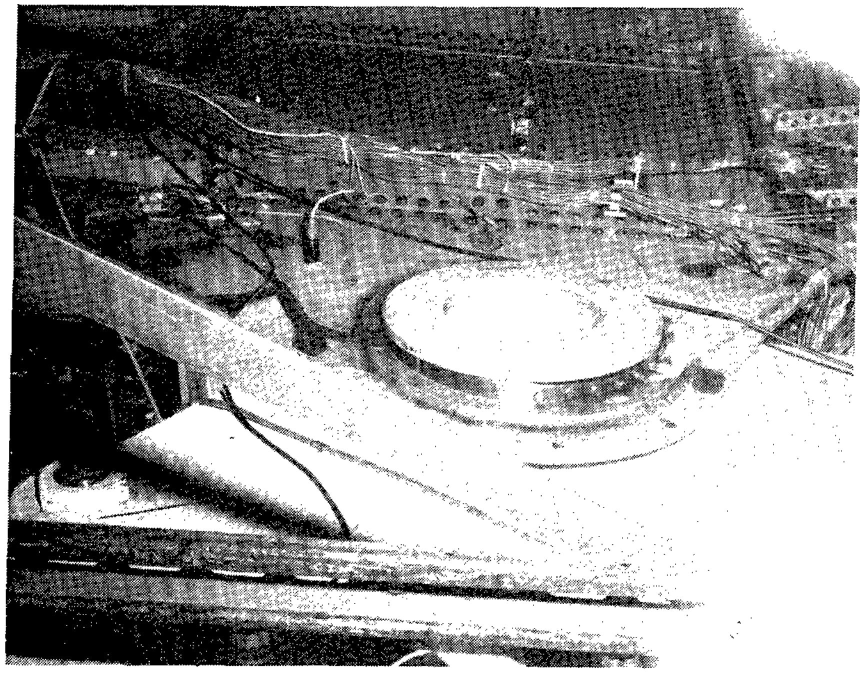


FIGURE 2.2.1-2

RETENTION OF UPPER BUSHING TO PIVOT PIN

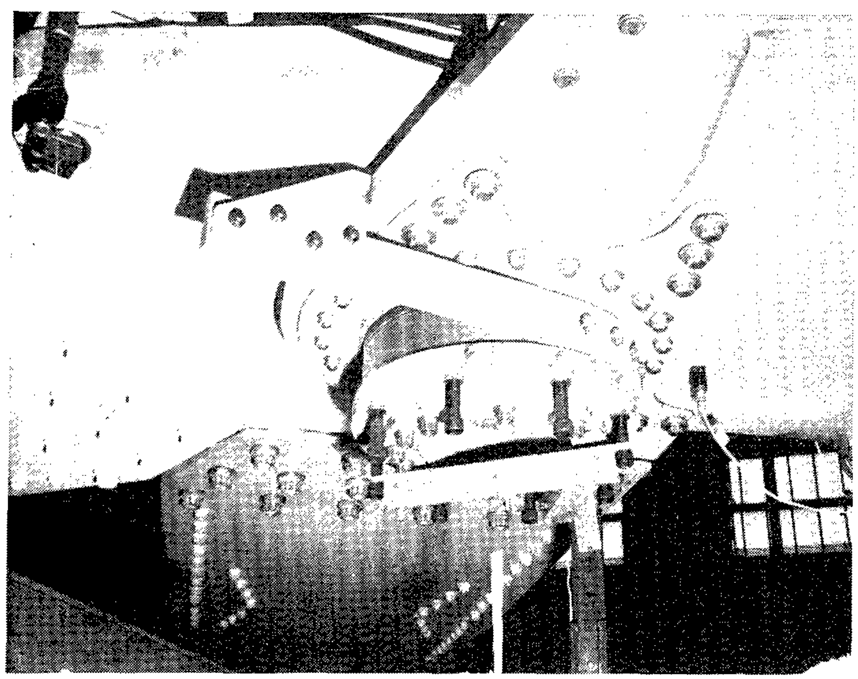


FIGURE 2.2.1-3

RETENTION OF LOWER BUSHING TO WCTS LOWER LUG

LH Hole Numbers			RH Hole Numbers		
E811	E841	E853	E802	E822	E850
E813	E845	E855	E804	E830	E852
E821	E847	E859	E806	E832	E854
E837	E849	E863	E810	E838	E856
E839	E851		E812	E840	E858

(See Sheets 1 and 2 of Figure 2.2.1-4 for Locations)

- o 4 loose fasteners attaching the RH closure rib to the Y_F 992 bulkhead. Hole Numbers: E262, E264, E266, E268.
- o 2 loose fasteners in the upper forward corner of the closure rib assemblies. LH hole number: B75, RH hole number: B76
- o 4 broken bolts attaching the lower skins of the forward simulated fuselage to the outboard longerons
- o Miscellaneous loose fasteners in the simulated fuselage
- o Evidence of relative motion between the closure ribs and the bulkheads. No evidence of fretting was observed.
- o The pivot pins, bushings, and spacers had repositioned as documented in Table 2.2.1-IV.

All loose fasteners were retorqued and the four broken fasteners in the simulated fuselage were replaced with new bolts of the next larger diameter. The minor repositioning of the pivot system and the motion between the closure rib and the bulkheads were not considered cause for alarm.

Ultrasonic inspection of 748 Taper-lok bolts and 28 straight shank fasteners was conducted to determine if any failures had occurred. Magnetic rubber inspection of 20 selected radii and 8 fastener holes in the lower plate was performed to determine if fatigue cracks had been initiated. All NDI inspections produced negative results.

Full scale fatigue testing was resumed 5 February with a three shift operation commencing 9 February. Completion of Flight 480 was achieved 12 February with the test time reduced to 23 minutes per flight, resulting in the best test rate to date of 53 flights per day.

Following completion of Flight Number 422 and during the routine daily visual inspection of 10 February, an additional fastener head failure was discovered in the right hand simulated fuselage. The failed fastener was the most aft Hi-Lok attaching the upper skin of the forward simulated fuselage (603FTB100-198) to the 603FTB301-63 splice angle as shown on Sheet 1 of 603FTB300. The splice angle attaches the fuselage skin to the 603FTB115 outboard longeron. Testing was resumed with the fastener still in place. After Flight 442 the Hi-lok was replaced with a shear bolt of the same diameter. During the replacement it was discovered that the fastener had also failed at the root thread.

During the down time following Flight 442, a failed bolt was discovered in hole C756 (RH side) of the WCTS. (Ref. Figure 2.2.1-5) The bolt is located in the upper outboard corner of the Y_F 932 bulkhead (X7224083) and penetrates the steel bulkhead, X_F 84 rib, corner gusset, and the support fitting for the bulkhead cap. A shank failure occurred at the interface between the X7224083 panel and the X7224090 bulkhead. Testing was resumed with the head end of the bolt removed and the nut end in place. At the end of Flight 447, a new C081-6 bolt was inserted and retained in place without adding a nut. The nut end of the failed bolt was removed at this time. Testing continued to the completion of Flight 480, at which time a nut was installed on the C081-6 bolt.

During the Category II inspection, following Flight 480, several bolts attaching the X7224061 panel to the Y_F 992 bulkhead were found to be loose. Loctite retaining compound was applied to the threads of these bolts and the bolts were retorqued. In addition, another bolt attaching the X7224061 panel to the Y_F 992 bulkhead was discovered to be broken. Failure of this bolt (hole E872) occurred at the head. This bolt is located approximately in-line with the inboard X722-4159 beam supporting the upper cover panel. (Ref. Figure 2.2.1-4, sheet 2) A temporary bolt (C081-6) was installed in this hole and Flight 481 was run 12 February.

A buckle in the 603FTB100-283 doubler reinforcing the upper skin of the LH forward simulated fuselage was first discovered following Flight 427. During the Category II inspection, a crack was found in the buckled doubler. No crack nor buckle, however, occurred in the basic skin. Six (6) 1/4" diameter bolts were added to attach the doubler to the skin in the area of the buckle.

Inspection of the bolts retaining the upper bushings to the pivot pins was omitted during the Category II inspection following Flight 480. Testing was discontinued after Flight 481 and an

inspection of these bolts was made. The most aft three (3) bolts on the LH side and the most aft bolt on the RH side were found broken at the first full thread. A temporary fix was accomplished. The failed bolts were reinserted in the holes and mechanically retained. This temporary fix permitted fatigue testing to resume until a repair kit from Fort Worth was assembled and delivered to WPAFB.

Failed bolts were discovered in Holes E860 and E864 following Flight 562. These bolts are part of a pattern attaching the X722-4061 bonded panel to the upper rail of the Y_F 992 bulkhead. (Ref. Figure 2.2.1-4) Temporary fasteners (C081) were installed and testing continued.

Following Flight 569, another failed bolt was discovered. This fastener was located in Hole C755 attaching the X_F 84 rib to the Y_F 932 bulkhead on the left hand side. The failure was similar to the failure in Hole C756, which is geometrically opposite C755 on the right hand side. A temporary replacement fastener (C081) was installed and testing continued.

The first one-half fatigue life (Flight 640) was completed 20 February at which time testing was discontinued to accomplish the second scheduled Category III inspection. The inspection was started 23 February and was completed 25 February. No discrepancies were observed by either ultrasonic inspection or magnetic rubber inspection. Visual inspection revealed the following:

- o Failure of two Hi-loks on the left hand side attaching the upper skin of the forward simulated fuselage to the splice angle of the outboard longeron. This splice area is geometrically opposite to the area where failure occurred on the right hand side. All Hi-lok fasteners in this splice area (four per side) were replaced with equivalent size shear bolts of 300,000 psi heat treatment.

- o Evidence of interference between the nut of the MLG Trunnion pin and the lower plate on the left hand side. Metal indentation was limited to the nonstructural lower fairing support flange - No visual damage occurred in the 10 Nickel lower plate. The nut was ground off to provide adequate clearance. No rework was required on the right hand side.

- o Indications of cracks in the Y_F 932 bulkhead lower flange and in the panel of the lower plate just inboard of the X_F 39 rib. NDI inspections, however, disproved the existence of the suspected cracks.

During the down time required to accomplish the Category III inspection, several repair and maintenance items were performed. The repair tasks included the following:

- o Replaced the temporary bolts (C081) in Holes C755, C756, E860, E864 and E872 with new original design C4550 bolts.
- o Replaced the deteriorating form-in-place gaskets on the two access covers of the Y_F 992 bulkhead.
- o Removed the failed bolts attaching the left hand upper bushing to the pivot pin and installed new bolts with gap provided between their heads and the bushing.

  NOTE: The one failed bolt on the right hand side was not removed because of breakage of removal devices and the possibility of damage if further removal attempts were made.

Preventive maintenance was performed to enhance the possibility of completing one fatigue life with minimum down time and included the following:

- o Replaced fasteners in Holes E841-E864 and E867-E878 with new bolts of original design, utilizing thread retaining compound to preclude loosening previously experienced.
- o Replaced original design titanium Hi-loks in Holes E865, E866 and E2025-E2028 with 260,000 psi heat treat shear bolts of the same diameter. These fasteners were also installed with thread retaining compound.
- o Replaced bolts in Holes C751 and C752 with new bolts of original design.
- o Replaced original design short threaded C081 bolts, attaching the aft access covers, with longer threaded NAS 674 bolts to allow proper engagement with the locking feature of the nutplates. Loosening of these fasteners had become frequent during testing.
- o Added three (3) bolts attaching the right hand doubler to the upper skin of the forward simulated fuselage. These fasteners were added to prevent doubler buckling as experienced on the left hand side.

Three additional strain gages were installed on the Y_F 992 bulkhead panel during the inspection down time. They were added in the area where bolt failures had been experienced to better define the load distribution and magnitude. (See Section 2.1.2.6)

Test resumption, following the second Category III inspection, was delayed to permit repair of a hydraulic cylinder in the wing sweep actuator system. Repair was required because of severely damaged piston rod threads found after removal of an inoperative load cell. Repair consisted of installing a replacement piston rod, which was created by modifying a longer rod from one of the static test hydraulic cylinders. The modification was completed and the actuator reinstalled 27 February. Additional delay was experienced due to discrepancies in a modified computer program. An attempt was made to incorporate a haversine shaped load cycle in the program to increase cyclic rate. Repeated dumps, however, necessitated converting back to the original program. This conversion was accomplished and testing resumed in Flight 641 on 1 March 1976.

Following Flight 783, it was observed that the head of a bolt attaching the upper skin of the right hand forward simulated fuselage to the outboard longeron (603FTB115) was missing. This bolt was the fourth fastener forward of the pattern changed from Hi-loks to shear bolts during the previous Category III inspection. A new bolt was installed during the Category II inspection following Flight 800.

A failed Taper-lok in Hole C84 (Ref. Figure 2.1.2-6, sheet 1) attaching the outboard Y_F 932 Bonded Panel (X7224083) to the X7224090 Bulkhead was discovered following Flight 802. Failure occurred in the first thread and was discovered because of the noise associated with excessive air leakage. The panel had pulled away from the bulkhead flange, allowing air to leak along the faying surface. An MRI inspection of the hole was negative, indicating no crack in the hole.

A team from General Dynamics arrived at WPAFB 8 March to rework the hole and install a new Taper-lok. The original hole, as manufactured, was a first oversize hole. Hole rework required enlarging the hole to the third oversize due to a slight misalignment between the panel and the bulkhead. Hole inspection consisted of blueing for a roundness check and a visual inspection for surface finish, angularity, tool mark, etc. A rubber cast of the hole was made following rework to provide a record of the hole condition. The new Taper-lok was installed and testing was resumed at Flight 803 on 8 March.

The second failure of the bolt in Hole C756 (Ref. Figure 2.1.2-5) was discovered at the end of Flight 876 on 10 March. A new bolt was installed without a nut and testing continued. The bolt was mechanically retained in place to eliminate down time involved in gaining access to the interior of the WCTS for nut installation.

Visual indications of cracks in the right hand closure rib web were discovered following Flight 885. Subsequent dye penetrant inspection, while the structure was under load, disproved the existence of cracks.

Following flight 936, a failed C081 fastener was found in the aft simulated fuselage. This fastener was the most forward fastener in the lower fastener pattern through a doubler immediately above the WCTS lower rail at the simulated fuselage center-line rib to Y_F 992 bulkhead attachment. A new C081 fastener was installed and testing was resumed.

On 12 March, Flight 960 was completed and testing was discontinued to allow accomplishment of the third scheduled Category III inspection.

The third scheduled Category III inspection was conducted by personnel at WPAFB. General Dynamics did not participate in this inspection. No abnormalities were detected by the nondestructive inspection techniques. Visual inspection, however, revealed the following:

- o Loose fasteners in the Y_F932 bulkhead at holes C293, C294, C295, C296, C315, C317, C341 and C127 (Ref. Figure 2.2.1-6, sheets 1 & 2) and hole C752 (Ref. Figure 2.2.1-5). These fasteners were properly retorqued with no other action deemed necessary.

- o Failed fastener in the forward simulated fuselage attaching the lower skin to the outboard longeron. This fastener was in the outboard row of fasteners and was just forward of two fasteners that had failed at flight 320 and were replaced by larger bolts. The fastener was replaced with same size fastener.

At flight 1036, cracks were found in both the left hand and right hand angles (P/N X7224169-13 and -14) attaching the lower fairing structure at X_F84 and Y_F932. Because of the secondary nature of this structure, no repairs were deemed necessary. By the end of 1280 flights, the cracks had terminated at rivet holes in the angle attachment.

At the completion of flight 1209, the Taper-lok fastener in hole E87 on the Y_F992 bulkhead (Ref. Figure 2.2.1-4, sheet 1) was found to have failed in the first thread. Inasmuch as visual inspection revealed no significant hole damage, a new Taper-lok of the same size was temporarily installed with head protrusion within the required limits. This action was accomplished by Structural Test personnel as an expedient to allow continued testing with the plan that General Dynamics would install a new fastener at completion of one service life.

During flight 1269, broken Hi-lok heads were found in the pattern attaching the outboard titanium panel (P/N X7224083) of the Y_F932 bulkhead to the X_F39 rib (Holes C424, C432, C436, C438, C421, C425 and C429 (Ref. Figure 2.2.1-9). Since the shanks were intact as well as portions of the head, the decision was made to continue testing until completion of the first life. At that time, all accessible Hi-loks in the pattern will be changed to C4550 shear bolts in order to gain greater head strength to resist prying induced by the single shear arrangement.

During inspection of the Hi-lok heads, a crack was discovered in the left hand angle attaching the simulated fuselage weapons bay skin to the Y_F932 bulkhead. The crack was in the flange attaching to the bulkhead and passed through hole C441. The crack terminated, however, before reaching the flange attaching the weapons bay skin. Because the shear loads in the weapons bay skin are relatively low, no repair was made.

The first service life of testing (1280 flights) was completed on 30 March 1976.

2.2.1.2 First Life Inspection and Change Incorporation

As discussed in paragraph 2.2.1.1, test down-time during the first service life was minimized by deferring incorporation of required changes until completion of the first life. A General Dynamics Team then incorporated the planned changes, participated in the Category IV inspection, and accomplished repairs revealed necessary by the inspection.

The planned changes were those WCTS modifications necessary to resolve design problems encountered in the first service life of fatigue testing. The planned modifications, along with the actual changes required to implement the modifications, were as follows:

a) Increase fastener size at X_F84 rib to Y_F 932 bulkhead attachment to provide positive margin at this joint. The planned change involved increasing the size of fastener holes as follows. (Ref. Figure 2.2.1-5 for hole identification).

   C755 and C756 - increase from 3/8 inch to 1/2 inch
   C751 and C752 - increase from 3/8 inch to 7/16 inch

   The planned rework, including appropriate inspection, was accomplished and new fasteners were installed in the reworked holes.

b) Replace Hi-lok fasteners in the X7224083 panel to X_F39 rib attachment with same size shear fasteners to provide greater fastener head strength and preclude further cracking of fastener heads.

   The planned rework, including inspection of involved holes, was accomplished and new C4550 shear bolts were installed in the following holes (Ref. Figure 2.2.1-9).

   C403 thru C442
   C451 thru C456

c) Increase fastener size and add new fasteners in the upper outboard area of the pattern attaching the X7224061 panel to the Y_F992 bulkhead to provide positive fastener margin. The planned modification involved increasing the size of 22 holes on each side from 3/8 inch to 7/16 inch plus adding one new 7/16 inch hole on each side to accommodate a new fastener.

As part of the planned rework, a baseline Magnetic Rubber Inspection (MRI) was accomplished on the holes to be reworked. This inspection revealed that several of the holes contained cracks. The cracks were corner cracks with the cracks visible on the inside of the hole and the inside edge of the 10 nickel steel bulkhead. Following rework of all holes to 7/16 inch diameter, cracks still were detected by MRI in twelve of the holes.

The consensus was that the cracks probably were the result of load redistribution when earlier bolt loosening and failures in the pattern occurred. Since the cracks probably would not have occurred if the design changes to create a positive margin had been incorporated at flight 320 (when analysis of the loosening problem indicated a design change was necessary), AFFDL and General Dynamics agreed that further rework should be accomplished to remove the remaining cracks. This additional rework consisted of countersinking (45^{o} X .03 inch) the inside surface of those holes containing cracks. If crack removal was not complete, the hole diameter was then increased to 1/2 inch. As shown below, it was necessary to increase the size of five holes in the pattern to 1/2 inch to remove all crack indications (Ref. Figure 2.2.1-4 for hole locations).

Original Plan Inc. from 3/8 to 7/16	Holes with Cracks After Inc. to 7/16	Holes with Cracks After Countersink	Inc. to 1/2 to Remove Cracks
44 holes (E839 thru E878 and E2025 thru E2028) plus add 2 new 7/16 holes (E3001 and E3002)	E839		
	840		
	842	842	842
	843		
	846	846	846
	847		
	850	850	850
	851	851	851
	852		
	856	856	856
	860		
	863		

d) Replacement of Taper-lok in hole E87 (Ref. Figure 2.2.1-4 for location). This replacement was not a planned WCTS modification but was necessary ro insure a proper installation after the temporary replacement installation made at time of failure (flight 1209).

Inspection of the hole revealed slight elongation. To eliminate the hole elongation and obtain proper protrusion, it was necessary to rework the hole to accommodate a .003 inch oversize Taper-lok. This was accomplished and a C4456 Taper-lok installed.

Non destructive inspection methods revealed no abnormalties during the planned Category IV inspection. Visual observations, however, revealed the following conditions:

- Broken bolt in the Y_F932 bulkhead at the left hand X_F84 rib (hole C755). This hole was increased in size from 3/8" to 1/2" as part of the above mentioned WCTS modification.

- Loose nut on the Taper-lok bolt in the Y_F932 bulkhead at hole C86. Although ultrasonic inspection of this fastener indicated no failure, a decision was made to remove the Taper-lok and inspect the condition of the hole. The hole was found to be slightly worked (out of round) and was reworked to accommodate an oversize Taper-lok to eliminate this condition.

- A gap between the Taper-lok head and washer on the Y_F932 bulkhead at the right hand X_F39 rib (hole C116). A washer was added under the nut and the Taper-lok torqued to seat its head.

- Indication of motion between the left hand lower bushing retention strap and the pin collar in the forward area. The attaching bolts in the forward end were removed and inspected. No bolt failures were found and no further action was taken.

- Cracks in the web of the Y_F932 lower fairing attach structure (P/N X7224166) in area of the X_F99 beam. The cracks extended inboard and outboard from the X_F99 beam and occurred on both the left and right hand sides. In this area, the forward simulated fuselage skin attaches to the horizontal flange of the X7224166 support. The vertical web of this support in turn, is restrained locally by the beam at X_F99. Because of the secondary nature of this structure, the cracks were "stop drilled" with 1/4" holes rather than repaired.

2.2.2 Material Testing

With completion of the Credible Option Tests during this reporting period, all material testing to be accomplished at Fort Worth is now complete. Tests completed during the reporting period consisted of the following:

Crack growth tests - 18 specimens
Material property tests - 60 specimens
on 10 Nickel Steel EB
and GTA weldments

There are 16 notched fatigue specimens (FTJ10940-151) at WPAFB to be tested to determine the effect of spectrum truncation on the fatigue life of 10 Nickel steel.

Test results for all of the above tests will be incorporated into the Material Property Data Test Report FZM 6148.

2.2.3 Component Testing

All component tests were completed prior to this reporting period with the exception of three Credible Option Fastener Evaluation Tests (603FTB059) which are being tested at WPAFB.

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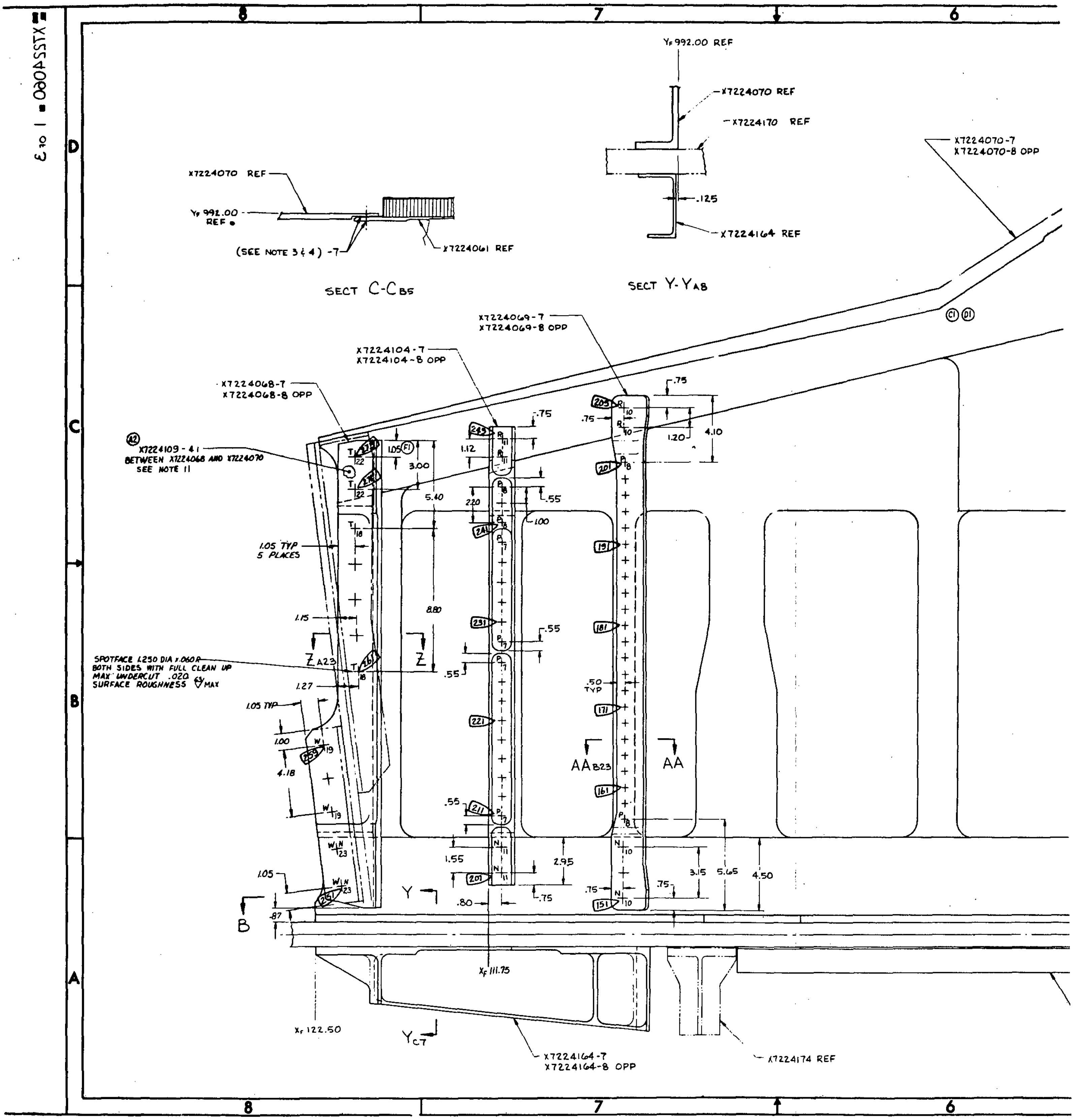
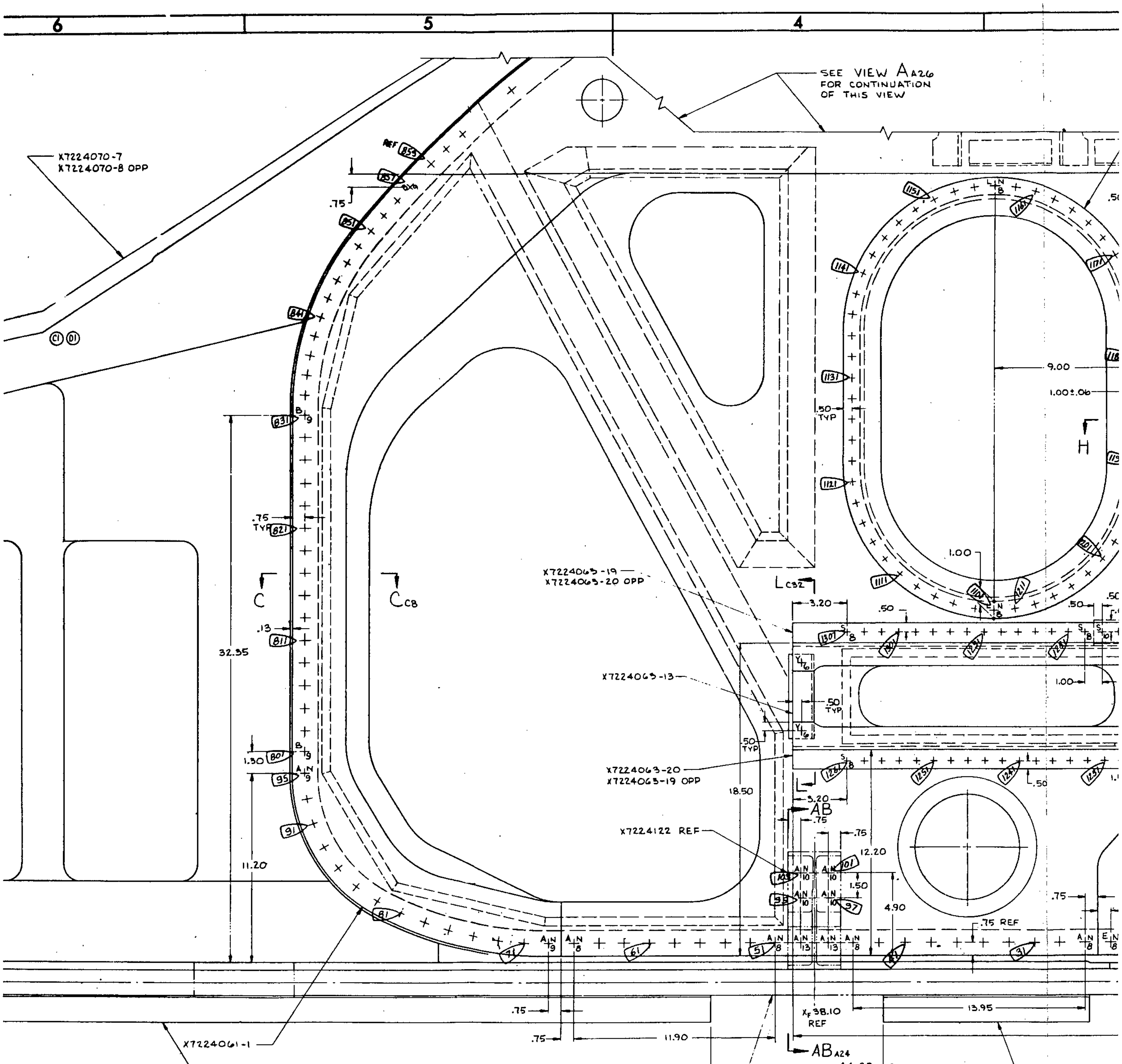


8
7
6
D
C
B
A
Yf 992.00 REF
X7224070 REF
X7224170 REF
.125
X7224164 REF
SECT Y-Y AB
X7224070-7
X7224070-8 OPP
X7224070 REF
Yf 992.00 REF
(SEE NOTE 3 & 4) -7
X7224061 REF
SECT C-C B5
X7224069-7
X7224069-8 OPP
X7224104-7
X7224104-8 OPP
X7224068-7
X7224068-8 OPP
X7224109-41
BETWEEN X7224068 AND X7224070
SEE NOTE 11
1.05 TYP
5 PLACES
SPOTFACE 1.250 DIA x .060R
BOTH SIDES WITH FULL CLEAN UP
MAX UNDERCUT .020
SURFACE ROUGHNESS MAX
1.05 TYP
Z A23
Z
AA B23
AA
Y
B
Xf 111.75
Xf 122.50
Y C7
X7224164-7
X7224164-8 OPP
X7224174 REF



-1 INSTL
VIEW LOOKING FWD LH SIDE
(ALL HOLES THIS VIEW PREFIXED 'E')

CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001	G	X7224060	1

SEE FRAME 1 SEE FRAME 2

Y

2

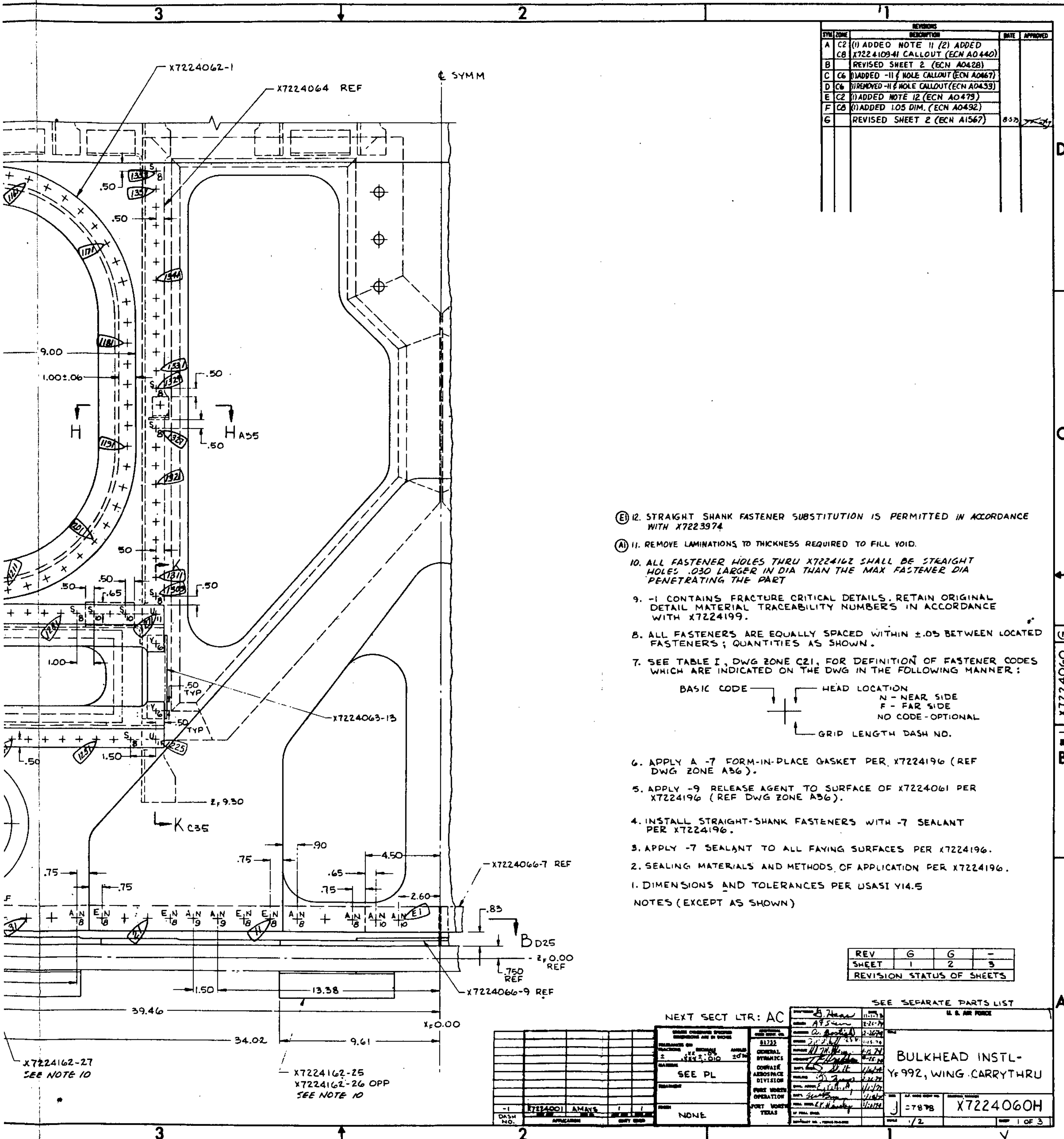
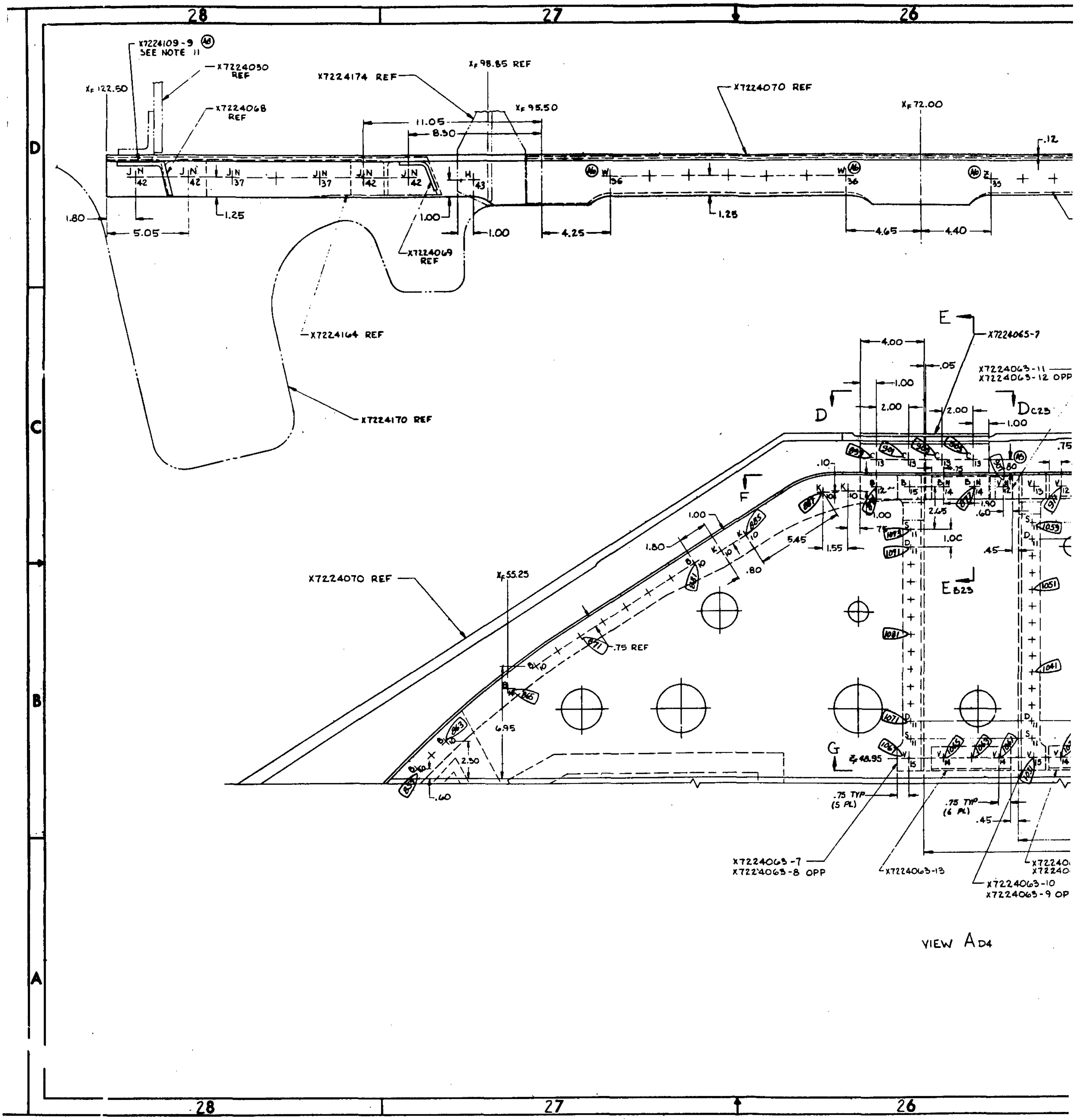
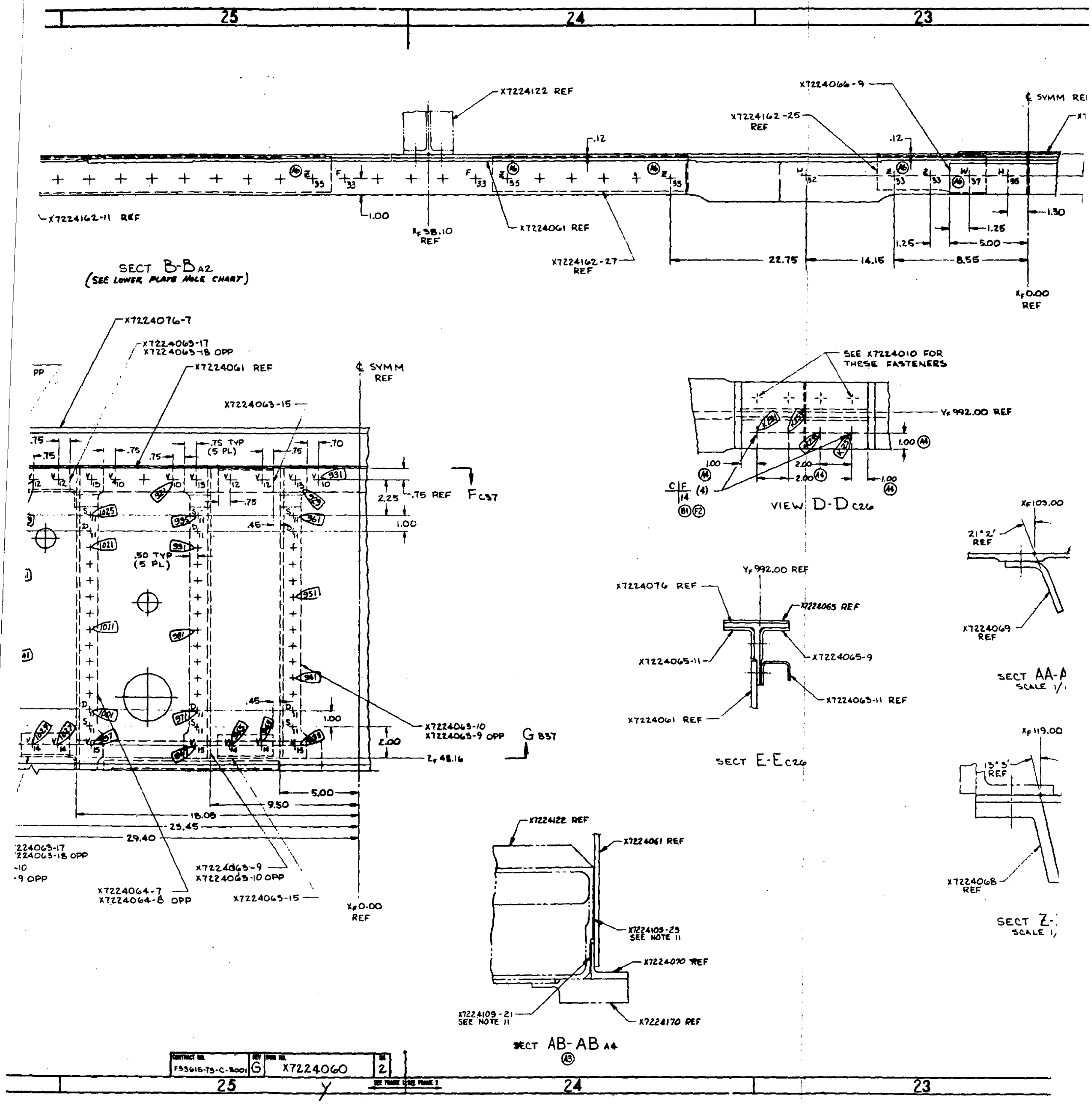


FIGURE 2.2.1-4, SHEET 1 OF 2

FASTENER HOLE IDENTIFICATION - Y_F 992 BULKHEAD

3

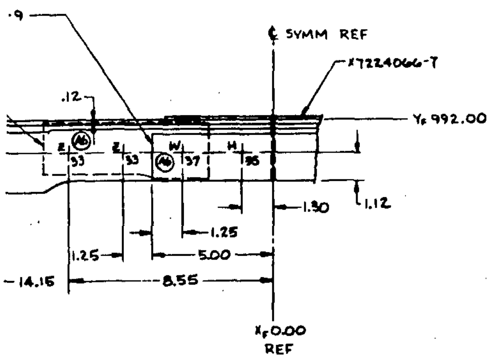

28
27
26
D
C
B
A
X7224109-9 (A8)
SEE NOTE 11
X7224030
REF
X7224068
REF
X7224174 REF
X$_F$ 98.85 REF
X$_F$ 95.50
X7224070 REF
X$_F$ 72.00
X$_F$ 122.50
11.05
8.50
1.80
5.05
1.25
1.00
4.25
4.65
4.40
.12
X7224069
REF
X7224164 REF
X7224170 REF
E
X7224065-7
X7224063-11
X7224063-12 OPP
D
D C25
F
X7224070 REF
X$_F$ 55.25
.75 REF
6.95
2.30
.60
G
E B25
.75 TYP
(5 PL)
.75 TYP
(6 PL)
X7224063-7
X7224063-8 OPP
X7224063-13
X7224063-10
X7224063-9 OP
VIEW A D4

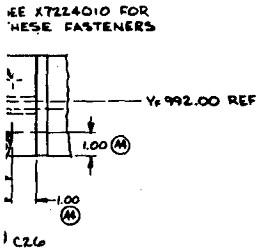


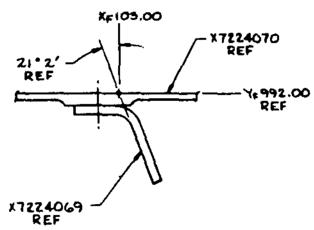
25
24
23
X7224122 REF
X7224066-9
¢ SYMM REF
X7224162-25 REF
X7224162-11 REF
X7224061 REF
X7224162-27 REF
SECT B-B A2
(SEE LOWER PLATE HOLE CHART)
X7224076-7
X7224063-17
X7224063-18 OPP
X7224061 REF
¢ SYMM REF
X7224063-15
SEE X7224010 FOR THESE FASTENERS
Y_F 992.00 REF
VIEW D-D C26
X7224076 REF
X7224065 REF
X7224065-11
X7224065-9
X7224063-11 REF
X7224061 REF
SECT E-E C26
SECT AA-A
X7224069 REF
X7224063-10
X7224063-9 OPP
X7224064-7
X7224064-8 OPP
X7224063-15
X7224122 REF
X7224061 REF
X7224109-25 SEE NOTE 11
X7224070 REF
X7224109-21 SEE NOTE 11
X7224170 REF
SECT AB-AB A4
X7224068 REF
SECT Z-
F33615-73-C-3001
G
X7224060
2

2

SYM	ZONE	REVISIONS DESCRIPTION	DATE	APPROVED
A	A24 C23 C24 D23- D27 B22 D28 B22 C22 A22	(3) ADDED SECT AB-AB (4) ADDED FSTNRS AND LOC DIMS. (5) .80 WAS 1.00 (6) REVISED FSTNR CODES, W WAS H, Z WAS F (7) ADDED Z FSTNR CODE TO TABLE I (8) ADDED X7224109-9 CALLOUT (9) ADDED OD TO FSTNR CODES F, H, J & N IN TABLE I. ADDED NOTE AT END OF TABLE		
B	C24	(1) FSTNR GRIP 18 WAS 13		
F	C24	(2) FSTNR GRIP 14 WAS 18		
G	B22	(1) 81755/C061-048 WAS NAS 1474C4 FOR NUT IN L FSTNR CODE	8-5-75	





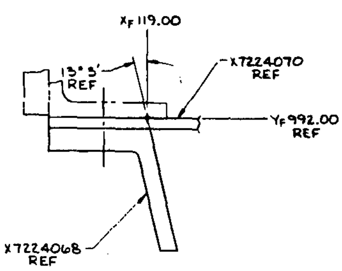


SECT AA-AA B7
SCALE 1/1

REF

065-9

24065-11 REF



SECT Z-Z B8
SCALE 1/1

TABLE I
FASTENER CODES
(SEE NOTE 7)

	BASIC CODE	HOLE DIA	FASTENER	NUT	WASHER (UNDER BOLT)	WASHER (UNDER NUT)	INSTL SPEC	TORQUE (IN-LB)
	A	SEE SPEC	X7223999-6-	81755/C389-6	81755/P511-10	NONE	X7223993-6	SEE SPEC
	B	.3770/.3746	X7223996-6-	81755/C077-6	X7223992-6	X7223994-6	NONE	160-390 Δ
	C	.5025/.4996	81755/C4550-8-	81755/C077-8	X7223992-8	X7223994-8	NONE	480-1100 Δ
	D	.2520/.2496	81755/C020-8-	81755/C2950-8	X7223991-8	X7223989-8	NONE	30-60 Δ
	E	SEE SPEC	X7223985-6-	81755/C389-6	NONE	NONE	X7223983-6	SEE SPEC
A9	F	SEE SPEC	81755/C513H8-OD	81755/C389-8	81755/P511-17	NONE	X7223993-8	SEE SPEC
	G	.3145/.3121	X7223996-5-	81755/C077-5	X7223992-5	X7223994-5	NONE	100-225 Δ
A9	H	SEE SPEC	81755/C513H10-OD	81755/C389-10	81755/P511-22	NONE	X7223993-10	SEE SPEC
A9	J	SEE SPEC	81755/C513H12-OD	81755/C389-12	81755/P511-24	NONE	X7223993-12	SEE SPEC
	K	.5025/.4996	X7223996-8-	81755/C077-8	X7223992-8	X7223994-8	NONE	480-1100 Δ
61	L	.289/.281	X7223996-4-	81755/C061-048	X7223992-4	NONE	NONE	50-100 Δ
	M	.2520/.2496	X7223995-4-	81755/C306-4	X7223988-4	X7223987-4	NONE	100-110 ⊠
A9	N	SEE SPEC	81755/C513H6-OD	81755/C389-6	81755/P511-10	NONE	X7223993-6	SEE SPEC
	P	.2520/.2496	81755/C3002-8-	81755/C2950-8	X7223991-8	NONE	NONE	50-100 Δ
	R	.3770/.3746	81755/C3002-12-	81755/C2950-12	X7223991-12	NONE	NONE	160-390 Δ
	S	.2520/.2496	X7223980-8-	81755/C2950-8	X7223991-8	X7223989-8	NONE	50-100 Δ
	T	.6275/.6241	X7223996-10-	81755/C077-10	X7223992-10	X7223994-10	NONE	1100-2400 Δ
	U	.3145/.3121	X7223980-10-	81755/C2950-10	X7223991-10	X7223989-10	NONE	60-140 Δ
	V	.3770/.3746	X7223980-12-	81755/C2950-12	X7223991-12	X7223989-12	NONE	160-390 Δ
	W	SEE SPEC	X7223999-10-	81755/C389-10	81755/P511-22	X7223986-10	X7223993-10	SEE SPEC
	Y	.2520/.2496	81755/C020-8-	81755/C2950-8	X7223991-8	NONE	NONE	30-60 Δ
A7	Z	SEE SPEC	X7223999-8-	81755/C389-8	81755/P511-17	X7223986-8	X7223993-8	SEE SPEC

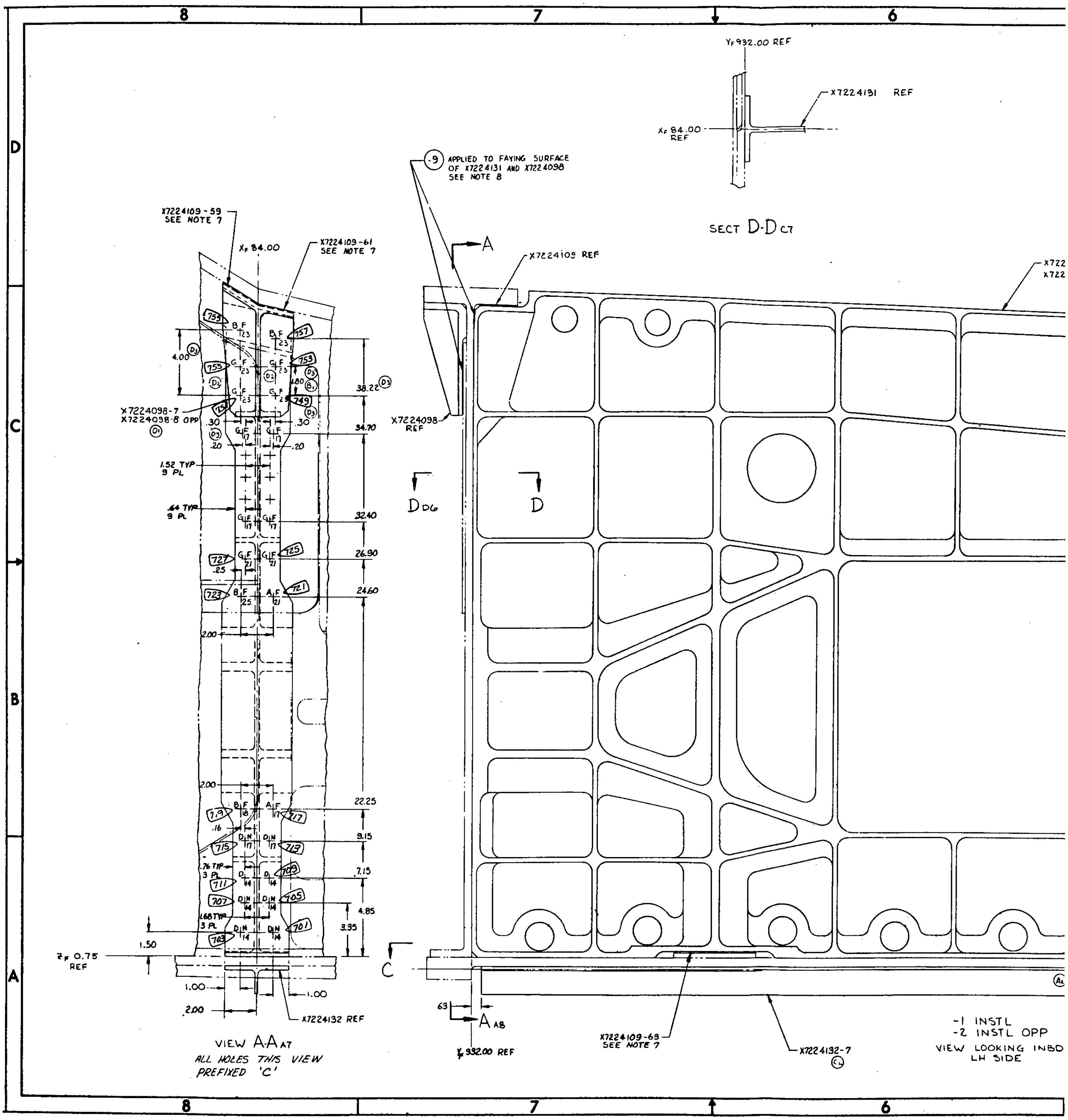
Δ - NOT LUBRICATED
⊠ - APPLY MIL-T-5544 THREAD COMPOUND TO FAYING SURFACES OF NUT SIDE WASHER, BOLT THREADS AND NUT THREADS.
A9 O DENOTES GRIP LENGTH DASH NO.

U. S. AIR FORCE		
BULKHEAD INSTL- Y_F 992, WING CARRYTHRU		
J	07878	X7224060H
		2

23 22 21

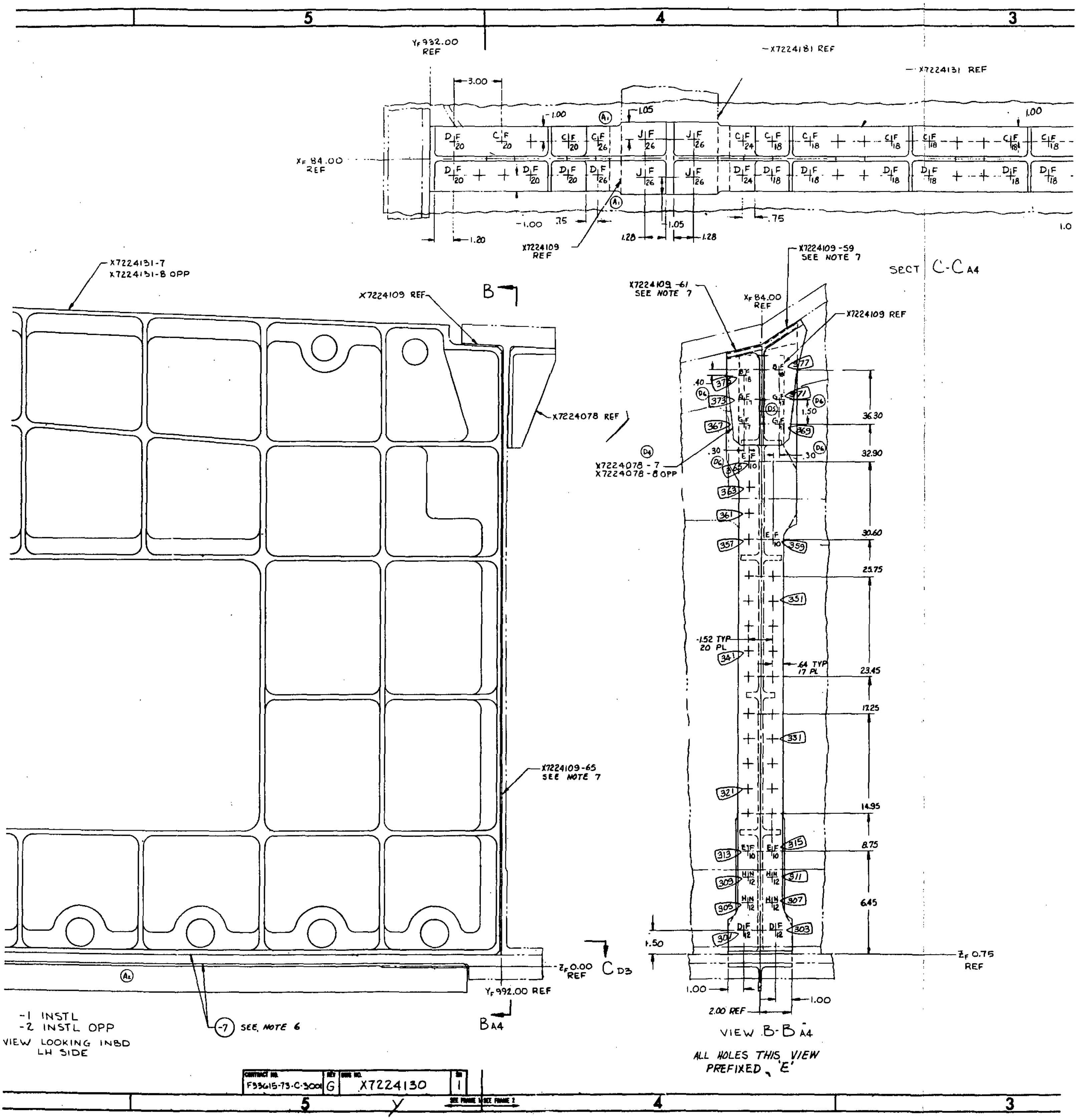
FIGURE 2.2.1-4, SHEET 2 OF 2
FASTENER HOLE IDENTIFICATION - Y_F 992 BULKHEAD

3



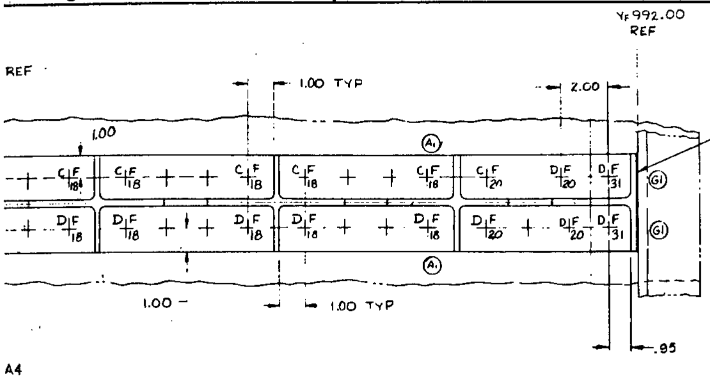
8
7
6
D
C
B
A
Yf 932.00 REF
X7224131 REF
Xf 84.00 REF
SECT D-D C7
-9 APPLIED TO FAYING SURFACE OF X7224131 AND X7224098 SEE NOTE 8
X7224109-59 SEE NOTE 7
X7224109-61 SEE NOTE 7
Xf 84.00
X7224109 REF
X7224098-7
X7224098-8 OPP
X7224098 REF
1.52 TYP 9 PL
.64 TYP 9 PL
38.22
34.70
32.40
26.90
24.60
22.25
9.15
7.15
4.85
3.35
1.50
Zf 0.75 REF
1.00
2.00
X7224132 REF
VIEW A-A A7
ALL HOLES THIS VIEW PREFIXED 'C'
X7224109-63 SEE NOTE 7
Yf 932.00 REF
X7224132-7
-1 INSTL
-2 INSTL OPP
VIEW LOOKING INBD
LH SIDE

1



5
4
3
Y_F 932.00 REF
X7224181 REF
X7224131 REF
3.00
1.00
1.05
1.00
X_F 84.00 REF
1.20
1.00
.75
1.28
1.05
1.28
.75
X7224109 REF
SECT C-C A4
X7224131-7
X7224131-8 OPP
X7224109 REF
B
X7224078 REF
X7224109 -61 SEE NOTE 7
X_F 84.00 REF
X7224109 -59 SEE NOTE 7
X7224109 REF
X7224078 - 7
X7224078 - 8 OPP
36.30
32.90
30.60
25.75
-1.52 TYP 20 PL
.64 TYP 17 PL
23.45
12.25
14.95
8.75
6.45
X7224109-65 SEE NOTE 7
Z_F 0.00 REF
C D3
Y_F 992.00 REF
B A4
Z_F 0.75 REF
1.50
1.00
2.00 REF
1.00
-1 INSTL
-2 INSTL OPP
VIEW LOOKING INBD LH SIDE
(-7) SEE NOTE 6
VIEW B-B A4
ALL HOLES THIS VIEW PREFIXED 'E'
CONTRACT NO. F33615-73-C-3001
REV G
DWG NO. X7224130
SH 1
SEE FRAME 1 SEE FRAME 2

2



REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
A	D2,3 4,A6	(1) REVISED GRIP LENGTHS OF FASTENERS (2) REVISED PICTURE OF X7224132		
B	C6	(1) 1.95 DIM WAS 1.50 (ECN B0945)		
C	C6	(1) DELETED X7224132-8 OPP (ECN A0458)		
D	C8,7 C4	(1) ADDED X7224038-7/8 (2) CHGD GRIP LENGTHS OF FASTENERS (3) CHGD DIMS 38.22 WAS 38.60, 1.80 WAS 1.95, 4.00 WAS 4.15, DELETED 1.30, ADDED .30 (1 PL) (4) ADDED X7224078-7/8, (5) CHGD GRIP LENGTHS (6) CHGD DIM 1.50 WAS 1.25, DELETED 1.25, ADDED .30 (2 PL), ADDED .40, ADDED .20 (2 PL) (ECN B1415)	6-13-74	
E	C2	(1) ADDED NOTE 9 (ECN A0483)		
F	C2	(1) ADDED NOTE 10 (2) ADDED "SEE NOTE 10" TO NOTE 8 (ECN B1482)		
G	D2	(1) 31 GRIP WAS 20 (ECN A1569)	9-19-75	

(F1) 10. -9 MOLDED SHIM MAY BE REPLACED WITH 81755/P103 PEEL SHIM TO FACILITATE ASSY. THE PEEL SHIM SHALL BE CUT TO SHAPE OF MATING SURFACE WITH THICKNESS SUFFICIENT TO FILL VOID WITHIN .005.

(E1) 9. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974

(F1) 8. CLEAN FAYING SURFACE OF X7224131 AND APPLY -9 MOLDED SHIM PER 81755/FPS-1071 CLASS II, TYPE II. SEE NOTE 10

7. REMOVE LAMINATIONS FROM X7224109 SHIM AS REQD TO FILL GAP.

6. APPLY -7 SEALANT TO ALL FAYING SURFACES PER X7224196.

5. INSTALL STRAIGHT-SHANK FASTENERS WITH -7 SEALANT PER X7224196.

4. SEALING MATERIALS AND METHODS OF APPLICATION PER X7224196.

3. ALL FASTENERS ARE EQUALLY SPACED BETWEEN LOCATED FASTENERS ; QUANTITIES AS SHOWN.

2. FASTENER CODE :

BASIC CODE — HEAD LOCATION (N) NEAR SIDE (F) FAR SIDE — GRIP LENGTH DASH NO.

BASIC CODE	HOLE DIA	FASTENER	NUT 81755/	WASHER UNDER HD	WASHER UNDER NUT	INSTL SPEC	TORQUE PER
A	.5025 .4996	81755/ C4550-8-	C077-8	X7223992-8	NONE	NONE	81755/ M016-8B
B	.5025 .4996	X7223996-8-	C077-8	X7223992-8	X7223994-8	NONE	81755/ M016-8B
C	SEE SPEC	X7223999-8-	C389-8	81755/ P511-16	NONE	X7223993-8	SEE SPEC
D	SEE SPEC	81755/ C5I3H8-ΔD	C389-8	81755/ P511-16	NONE	X7223993-8	SEE SPEC
E	.3770 .3746	81755/ C3002-12-	C2950-12	X7223991-12	NONE	NONE	81755/ M016-6A
F	.3770 .3746	81755/ C4550-6-	C077-6	X7223992-6	NONE	NONE	81755/ M016-6B
G	.3770 .3746	X7223996-6	C077-6	X7223992-6	X7223994-6	NONE	81755/ M016-6B
H	SEE SPEC	81755/ C5I3H6-ΔD	C389-6	81755/ P511-10	NONE	X7223993-6	SEE SPEC
J	SEE SPEC	X7223999-10-	C389-10	81755/ P511-22	NONE	X7223993-10	SEE SPEC

Δ INDICATES GRIP DASH NO. FOR "D" AND "H" FASTENERS

1. DIMENSIONS AND TOLERANCES PER USASI Y14.5

NOTES (EXCEPT AS SHOWN)

$_F$ 0.75
REF

SEE SEPARATE PARTS LIST

NEXT SECTION LETTER: E

U. S. AIR FORCE

SEE PL

CONVAIR AEROSPACE DIVISION

FORT WORTH OPERATION

FORT WORTH, TEXAS

RIB INSTL - X_F 84, WING CARRYTHRU

J 07878 X7224130H

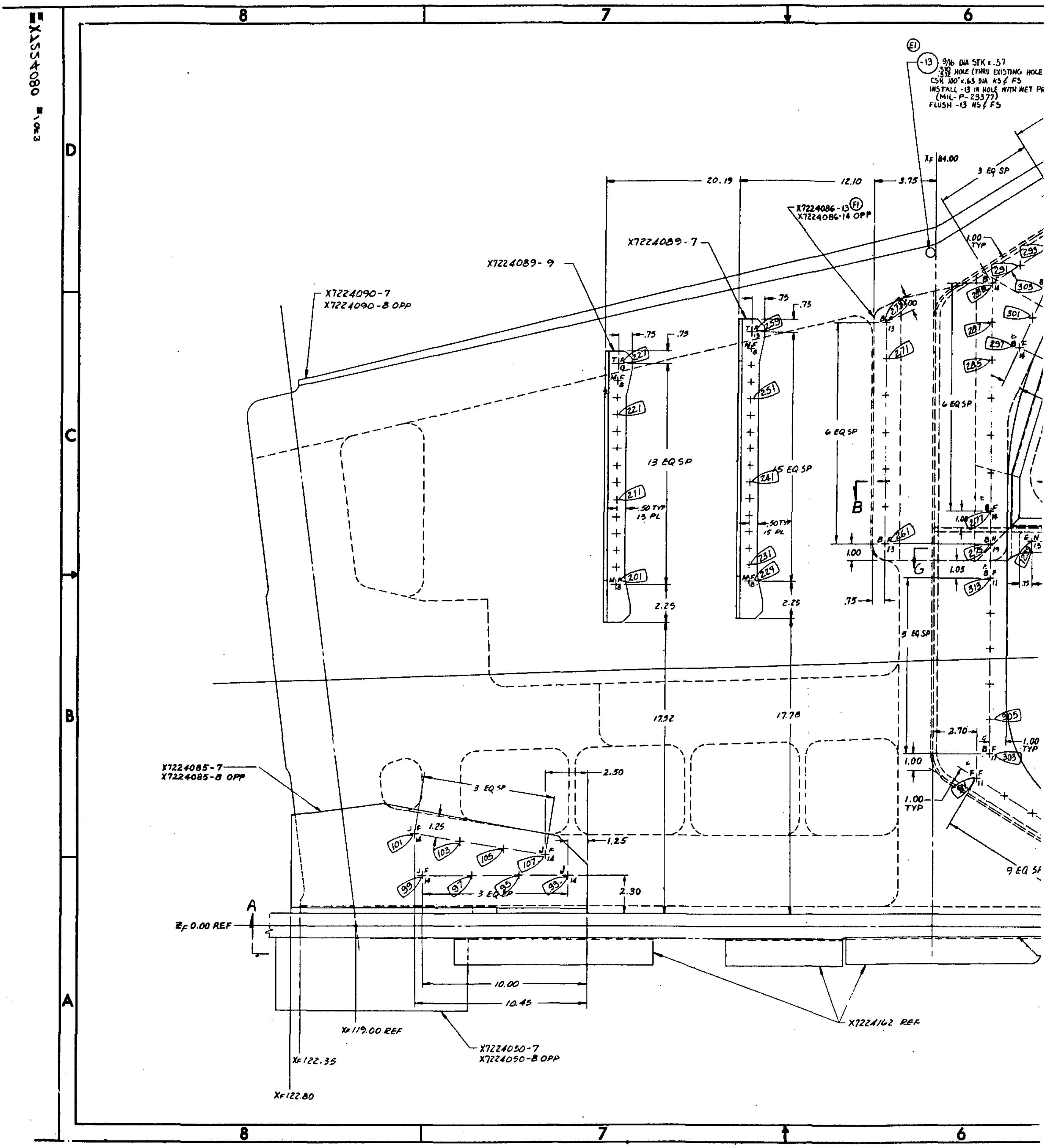
1 OF 1

-2	X7224001	AMAYS
-1	X7224001	AMAYS

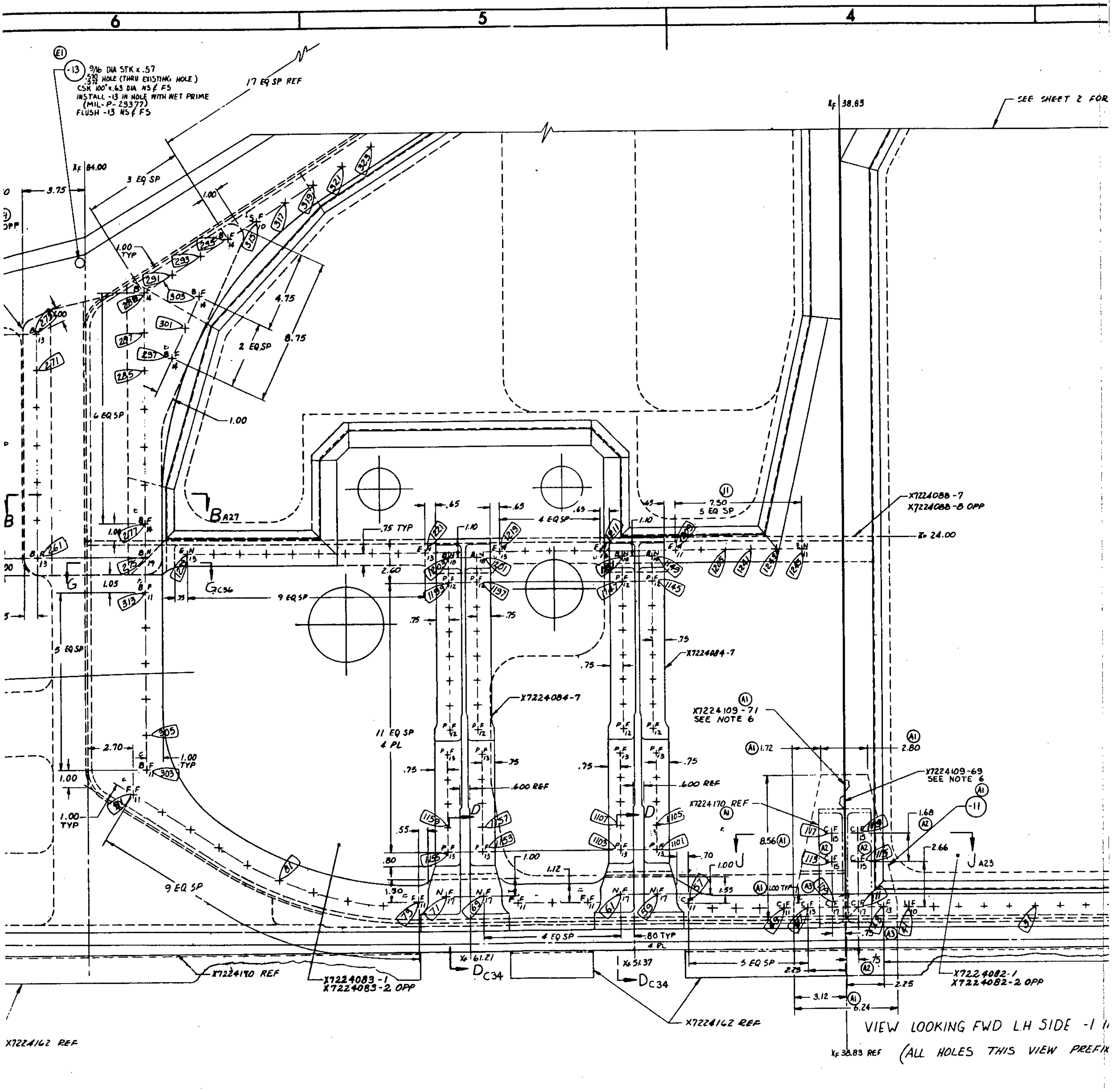
3

FIGURE 2.2.1-5

FASTENER HOLE IDENTIFICATION - X_F 84 RIB



X7224090-7
X7224090-8 OPP
X7224089-9
X7224089-7
X7224086-13
X7224086-14 OPP
9/16 DIA STK x .57
CSK 100° x .63 DIA NS & FS
INSTALL -13 IN HOLE WITH WET PR
(MIL-P-23377)
FLUSH -13 NS & FS
20.19
12.10
3.75
3 EQ SP
13 EQ SP
15 EQ SP
6 EQ SP
5 EQ SP
9 EQ SP
.50 TYP
13 PL
15 PL
2.25
17.52
17.78
X7224085-7
X7224085-8 OPP
3 EQ SP
2.50
1.25
2.30
10.00
10.45
Z_F 0.00 REF
X_F 119.00 REF
X7224050-7
X7224050-8 OPP
X_F 122.35
X_F 122.80
X7224162 REF
X_F 84.00
1.00 TYP
2.70

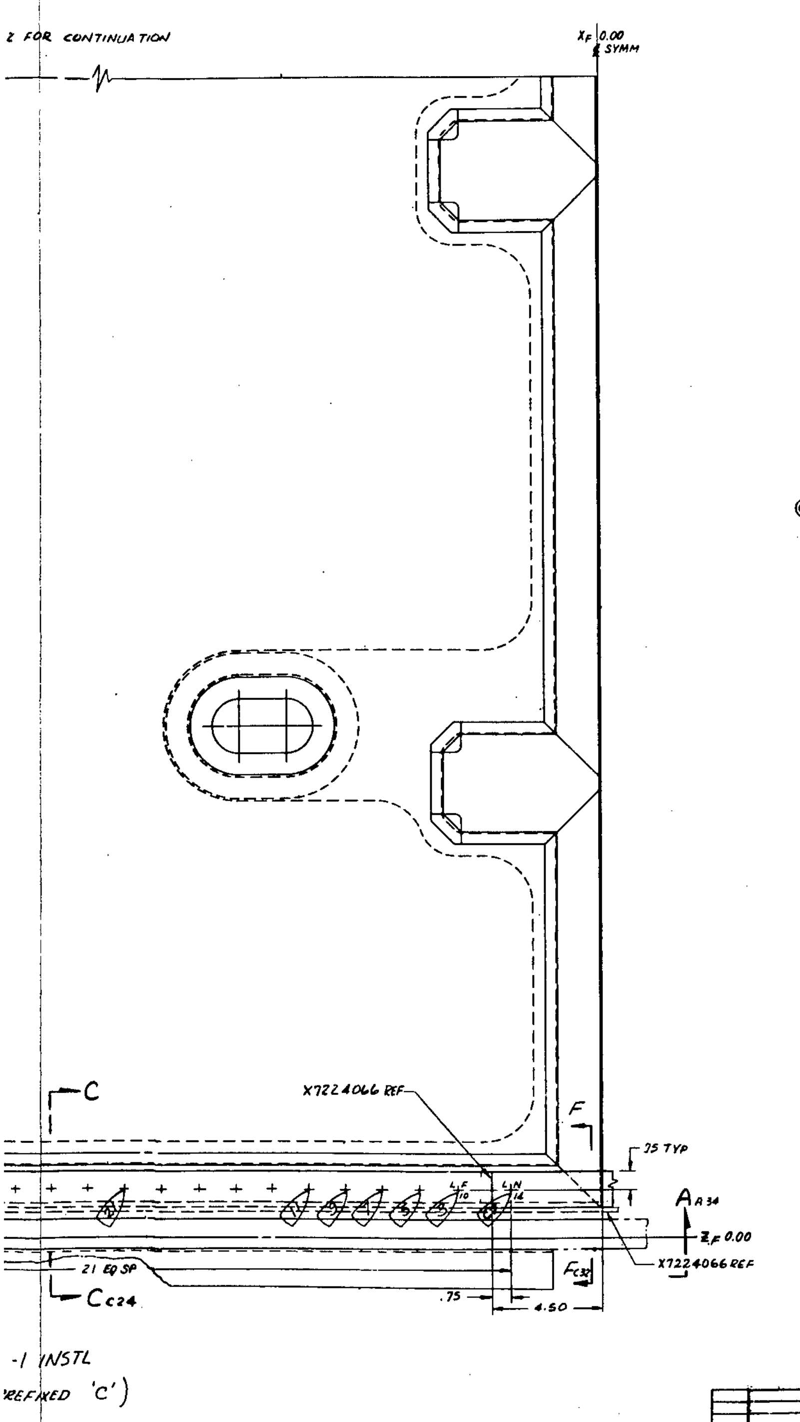


CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001	L	X7224080	1

SEE FRAME 1 | SEE FRAME 2

2

SYM	ZONE	DESCRIPTION	DATE	APPROVED
A	B4 B4 B4 A2 A2 B1	(1) ADDED -11, X7224109-49 & -71, X7224170 PICTURE & CALLOUT (2) ADDED FSTNR & LOC DIM COMMON TO X7224170 (3) REVISED FSTN R (4) ADDED NOTE 9 (5) ADDED SEE NOTE 9 TO FINISH BLK (6) ADDED FSTNR CODES V & W TO NOTE 1, DELETED CODE U (7) WASHER HD SIDE FOR G CODE WAS 81755/P511-17 (ECN A0499)		
B		REVISED SHEETS 2 & 3 (ECN B0944)		
C		REVISED SHEET 2 (ECN A0450)		
D		REVISED SHEET 2 (ECN A0465)		
E	D6	(1) ADDED -13 & HOLE CALLOUT (ECN A0464)		
F	D6	(1) X7224086-13/-14 WAS X7224086-3/-4 (ECN A0479)		
G	C2	(1) ADDED NOTE 10 (ECN A0480)		
H	A1	(1) NUT FOR R CODE OF NOTE 1 WAS 81755/C4520-12 (ECN A0486)		
J	C4	(1) ADDED FSTNRS, WAS 1.50 & 3.00 (ECN A0495)		
K		REVISED SHEET 3 (ECN A1585)		
L	C2	(1) ADDED NOTES 11, 12, 13 & 14 (ECN A1586	8-11-75	



(L1) 14. PROTECTIVE FINISH -15 AS FOLLOWS:
A. CLEAN AND APPLY CHEMICAL FILM PER MIL-C-5541
B. APPLY ONE COAT MIL-P-23377 EPOXY- POLYAMIDE PRIMER PER MIL-F-18264

13. I.D. AND O.D. OF -15 TO BE CONCENTRIC WITHIN .020 TOTAL INDICATOR READING

12. ALL EDGES OF -15 TO BE .015 R OR CHAM 45° x .015

(L1) 11. INSTALL 81755/C4431-12-49 TAPER LOKS PER X7223993-12 EXCEPT AS NOTED BELOW:
A. 81755/C4431-12-49 (GROUP 4) IS THE ONLY FASTENER PERMITTED AT THESE LOCATIONS
B. PREPARE HOLE TO OBTAIN HEAD PROTRUSION ABOVE STRUCTURE FACE (NOT WASHER FACE) OF .302 MIN TO .720 MAX
C. TRIM THICKNESS OF -15 WASHER (SURFACE OPP CSK) TO OBTAIN THE PROTRUSION 'P' AS SPECIFIED IN X7223993-12. RESTORE PROTECTIVE FINISH TO REWORKED SURFACE
D. CAUTION: EXTREME CARE MUST BE EXERCISED IN HOLE PREPARATION SINCE NO OVERSIZE BOLTS ARE PERMISSIBLE

(G1) 10. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974

(A4) 9. FINISH -11 AS FOLLOWS:
A. CLEAN PER MIL-S-5002
B. APPLY ONE COAT MIL-P-23377 EPOXY-POLYAMIDE PRIMER PER MIL-F-18264

8. PENETRANT INSPECT -9 PER 81155/FPS-10E4, ZONE O.

7. ALL FASTENER HOLES THRU X7224162 SHALL BE STRAIGHT HOLES .030 LARGER IN DIA THAN THE MAX FASTENER DIA PENETRATING THE PART

6. REMOVE LAMINATIONS TO THICKNESS REQUIRED TO FILL VOID

5. APPLY -7 SEALANT TO FAYING SURFACES INDICATED AND TO SHANK OF ALL STRAIGHT SHANK BOLTS. SEALANT MATL & METHOD OF APPLICATION PER X7224196

4. MARK PARTS PER X7224198, CL 2A

3. -1 CONTAINS FRACTURE CRITICAL DETAILS RETAIN ORIGINAL DETAIL MATERIAL TRACEABILITY NUMBERS IN ACCORDANCE WITH X7224199

2. DIMENSIONS & TOLERANCES PER USASI Y14.5

1. FASTENER CODE
- BASIC CODE
- HEAD LOCATION (N) NEAR; (F) FAR, NO CODE OPTIONAL
- GRIP LENGTH DASH NO.

Δ - NOT LUBRICATED   □ INDICATES GRIP FOR G, J, K & L FASTENERS

BASIC CODE	HOLE DIA	FASTENER	NUT	WASHER HEAD SIDE	WASHER NUT SIDE	TORQUE IN.-LB	INSTL SPEC
A	.6275 .6241	X7223996-10-	81755/C077-10	X7223992-10	X7223994-10	100-2400Δ	NONE
B	.3770 .3746	X7223996-6-	81755/C077-6	X7223992-6	X7223994-6	160-390Δ	NONE
C	SEE SPEC	X7223999-6-	81755/C389-6	81755/P511-10	NONE	SEE SPEC	X7223993-6
D	.3770 .3746	X7223980-12-	81755/C2950-12	X7223991-12	NONE	160-390Δ	NONE
E	.3770 .3746	81755/C020-12-	81755/C2950-12	X7223991-12	X7223989-12	160-390Δ	NONE
F	SEE SPEC	X7223999-8-	81755/C389-8	81755/P511-16	NONE	SEE SPEC	X7223993-8
(A7) G	SEE SPEC	81755/K513H8-□□	81755/C389-8	81755/P511-16	NONE	SEE SPEC	X7223993-8
H	.6275 .6241	81755/K4550-10-	81755/C077-10	X7223992-10	X7223994-10	100-2400Δ	NONE
J	SEE SPEC	81755/K513H10-□□	81755/C389-10	81755/P511-22	NONE	SEE SPEC	X7223993-10
K	SEE SPEC	81755/K513H12-□□	81755/C389-12	81755/P511-24	NONE	SEE SPEC	X7223993-12
L	SEE SPEC	81755/K513H6-□□	81755/C389-6	81755/P511-10	NONE	SEE SPEC	X7223993-6
M	.2520 .2496	81755/C020-8-	81755/K2950-8	X7223991-8	NONE	30-60 Δ	NONE
N	SEE SPEC	X7223999-8-	81755/K389-8	81755/P511-16	X7223986-8	SEE SPEC	X7223993-8
P	SEE SPEC	X7223999-6-	81755/K389-6	81755/P511-10	X7223986-6	SEE SPEC	X7223993-6
(H1) R	SEE SPEC	X7223979-12-	81755/TUN100 HL12	81755/P511-25	X7223986-12	SEE SPEC	X7223993-12
S	.5025 .4996	X7223996-8-	81755/K077-8	X7223992-8	X7223994-8	480-1100Δ	NONE
T	.3770 .3746	81755/K4550-6-	81755/K077-6	X7223992-6	X7223994-6	160-390Δ	NONE
(A6) V	SEE SPEC	X722397-10 -	81755/K389-10	81755/P511-22	X7223986-10	SEE SPEC	X7223993-10
W	SEE SPEC	X7223999-12-	81755/K389-12	81755/P511-24	X7223986-12	SEE SPEC	X7223993-12

NOTES (EXCEPT AS SHOWN)

SEE SEPARATE FASTENER LIST

REV STATUS	
SH	REV
1	L
2	L
3	L

NEXT SECT LETTER: K

-1 | X7224001 | AMAVS

SEE PL

SEE NOTE 9

GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION

U. S. AIR FORCE

BULKHEAD INSTL - Y_F 932.00

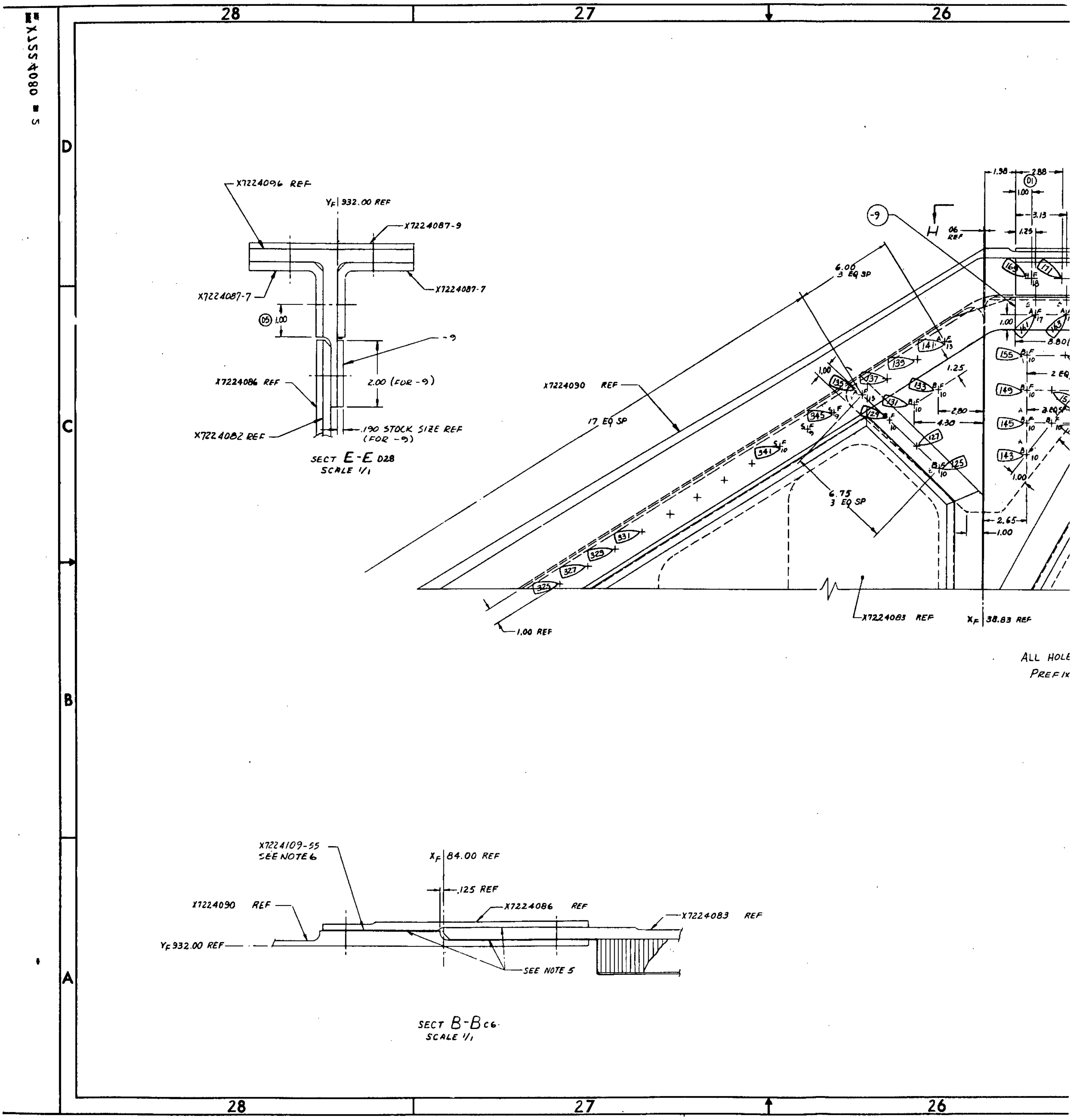
J | 07878 | X7224080H

SHEET 1 OF 3

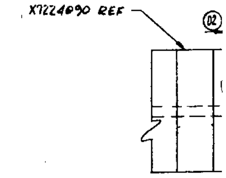
X7224080 L

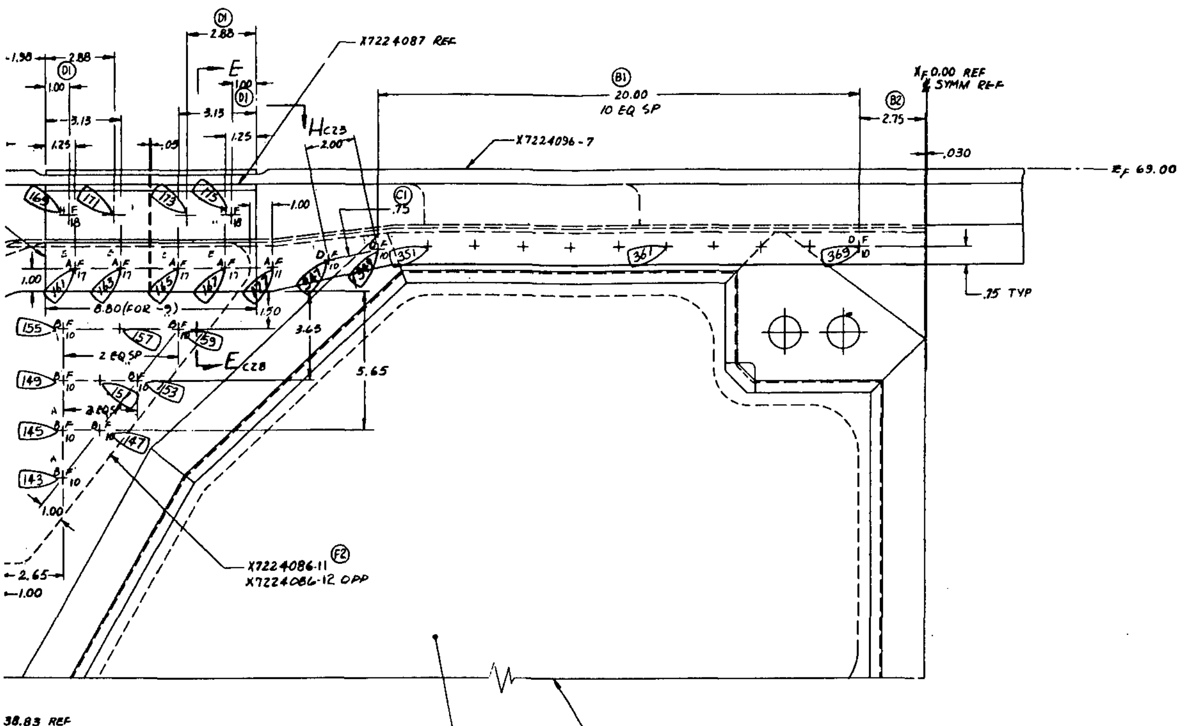
3

FIGURE 2.2.1-6, SHEET 1 OF 2
FASTENER HOLE IDENTIFICATION - Y_F 932 BULKHEAD

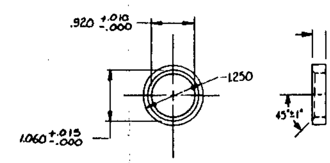


28
27
26
D
C
B
A
X7224096 REF
Y_F 932.00 REF
X7224087-9
X7224087-7
X7224087-7
1.00
-9
X7224086 REF
2.00 (FOR -9)
X7224082 REF
.190 STOCK SIZE REF (FOR -9)
SECT E-E D28
SCALE 1/1
-9
6.00
3 EQ SP
X7224090 REF
17 EQ SP
6.75
3 EQ SP
1.00 REF
X7224083 REF
X_F 38.83 REF
ALL HOLE
PREFIX
X7224109-55
SEE NOTE 6
X_F 84.00 REF
.125 REF
X7224090 REF
X7224086 REF
X7224083 REF
Y_F 932.00 REF
SEE NOTE 5
SECT B-B C6
SCALE 1/1

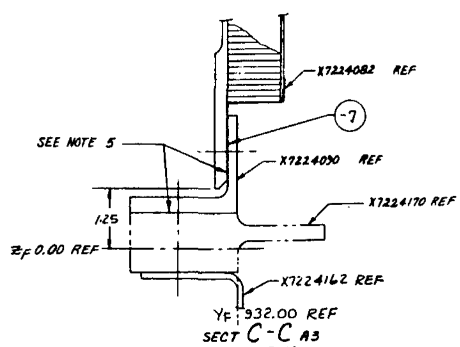




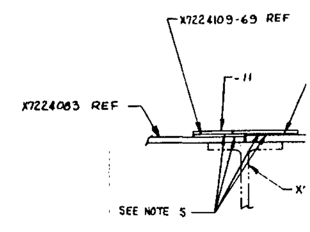
ALL HOLES THIS VIEW
PREFIXED 'C'



DETAIL -15 (L2)
MATL: .312 x 2 x 2
SPEC QQ-A-250/4 -T851
(SCALE 1/1)



SECT C-C A3
SCALE 1/1

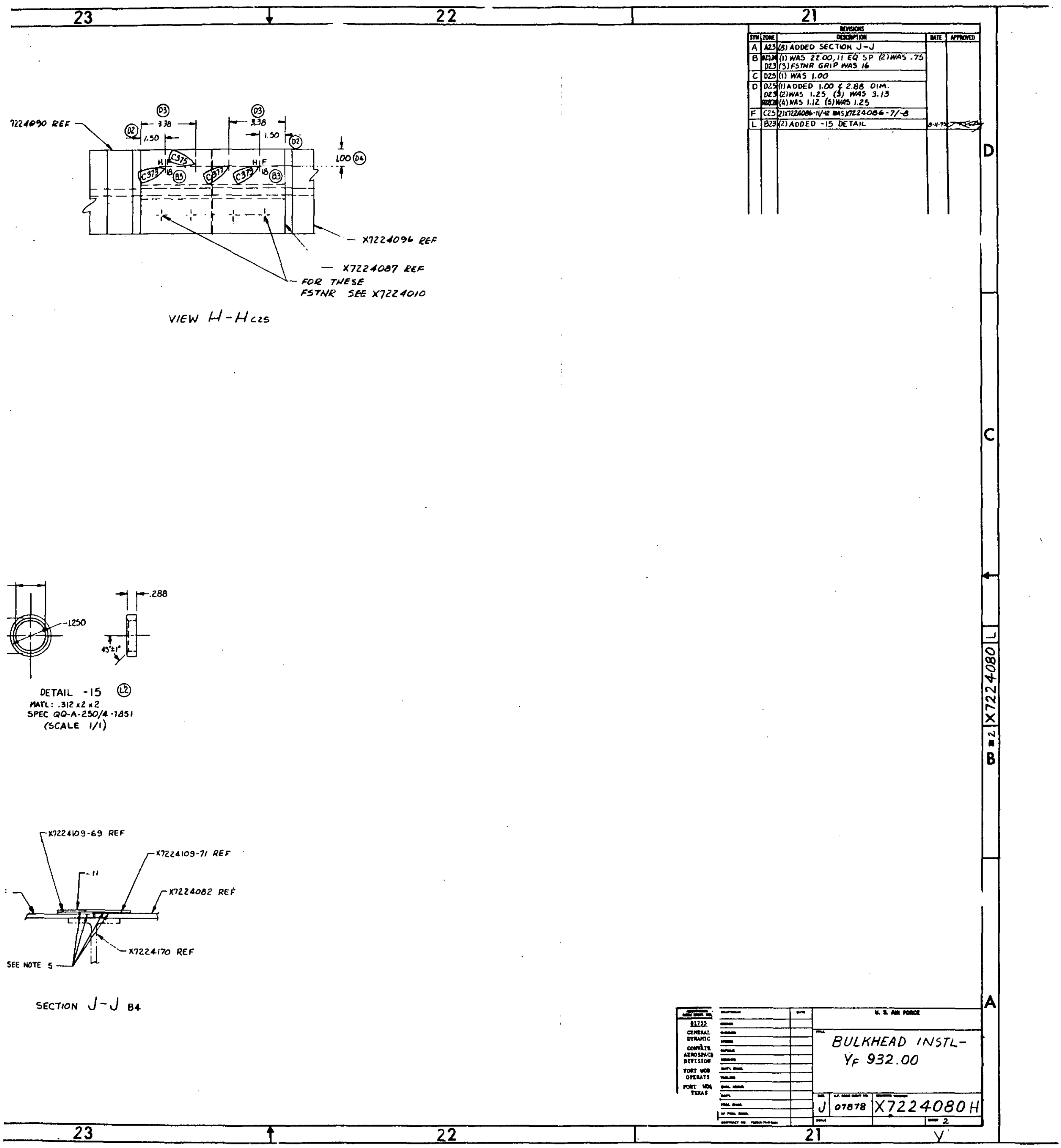


SECTION J-J B

CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C3001	L	X7224080	2

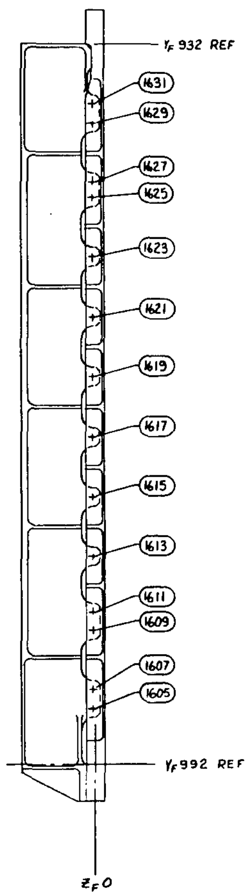
SEE FRAME 1 SEE FRAME 2

2



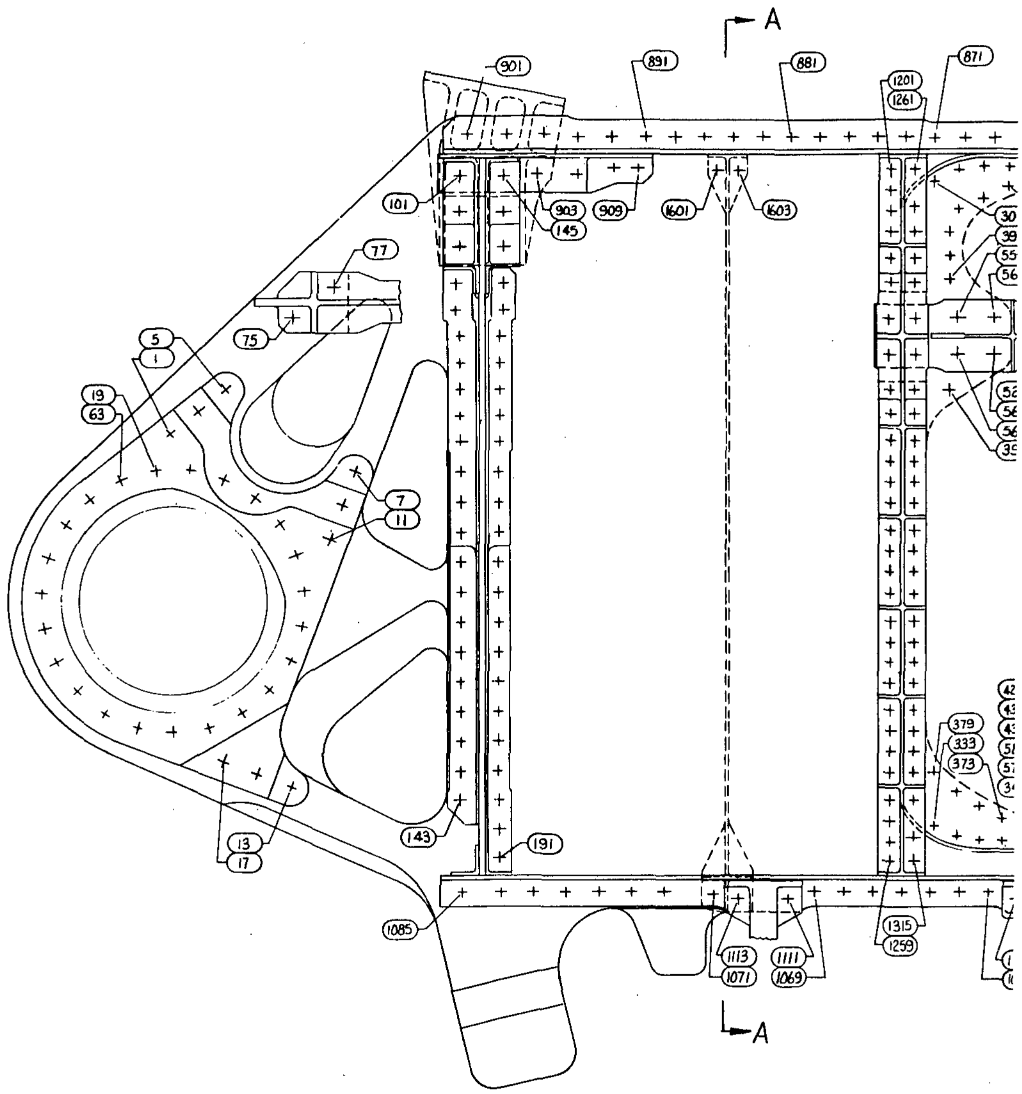
3

FIGURE 2.2.1-6, SHEET 2 OF 2
FASTENER HOLE IDENTIFICATION - Y_F 932 BULKHEAD

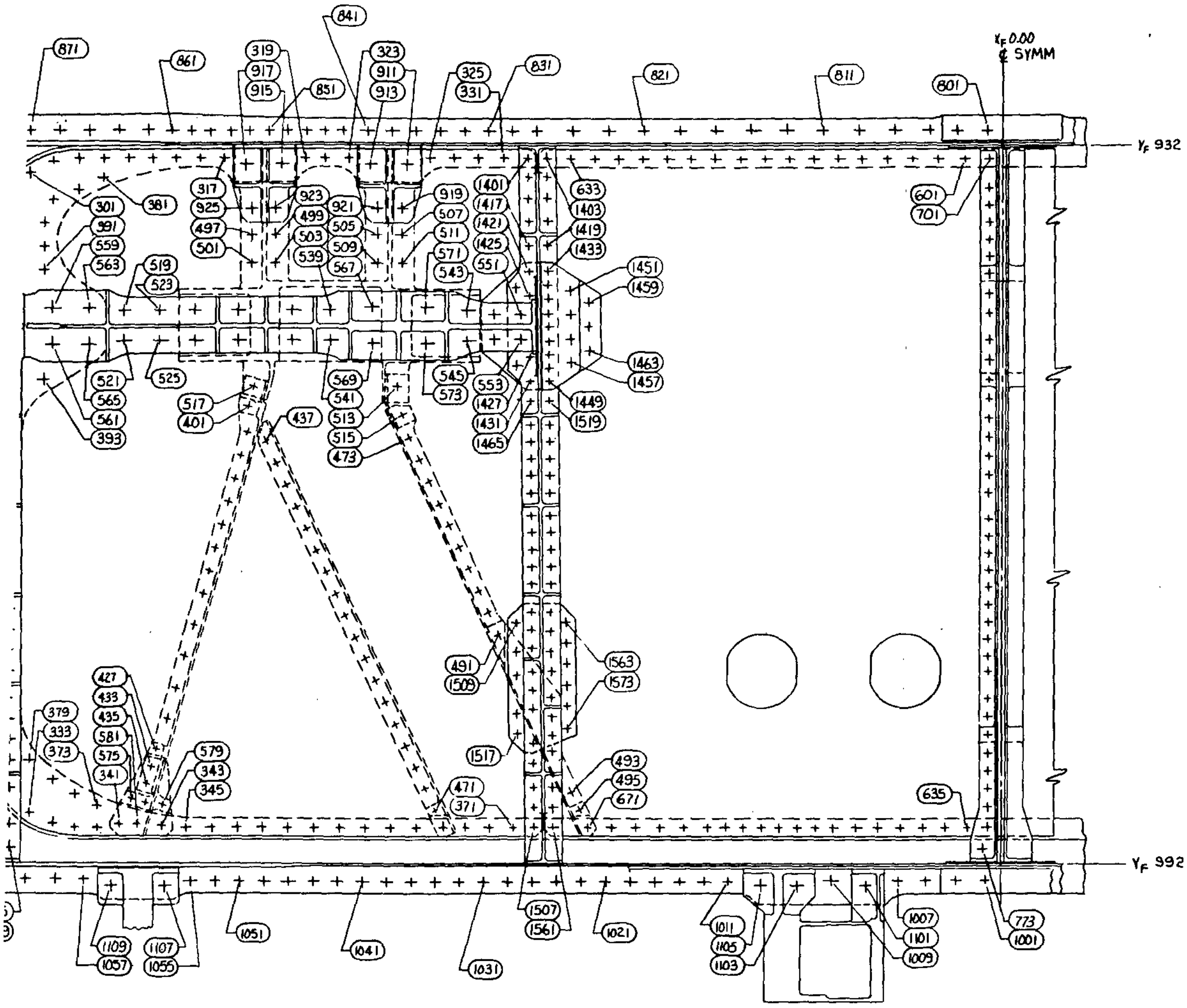


Y_F 932 REF
1631
1629
1627
1625
1623
1621
1619
1617
1615
1613
1611
1609
1607
1605
Y_F 992 REF
Z_F 0

SECTION A-A



A
901
891
881
871
1201
1261
101
145
903
909
1601
1603
77
75
5
1
19
63
7
11
13
17
143
191
1085
1113
1071
1111
1069
1315
1259
379
333
373
A

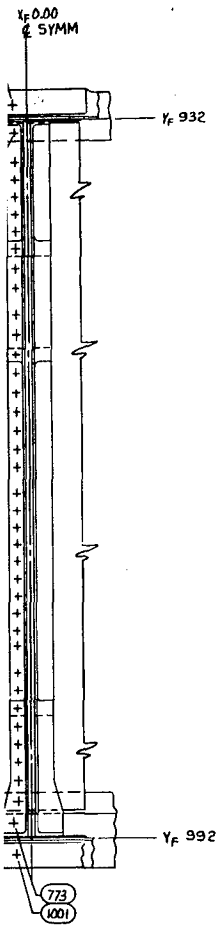


PLAN VIEW
LOWER SURFACE
'A' PLANE HOLE NUMBERS

2. EVEN NUMBERS - RH
1. ALL HOLES PREFIXED
NOTES ~

2

FI(
FASTENER HOLE IDEI

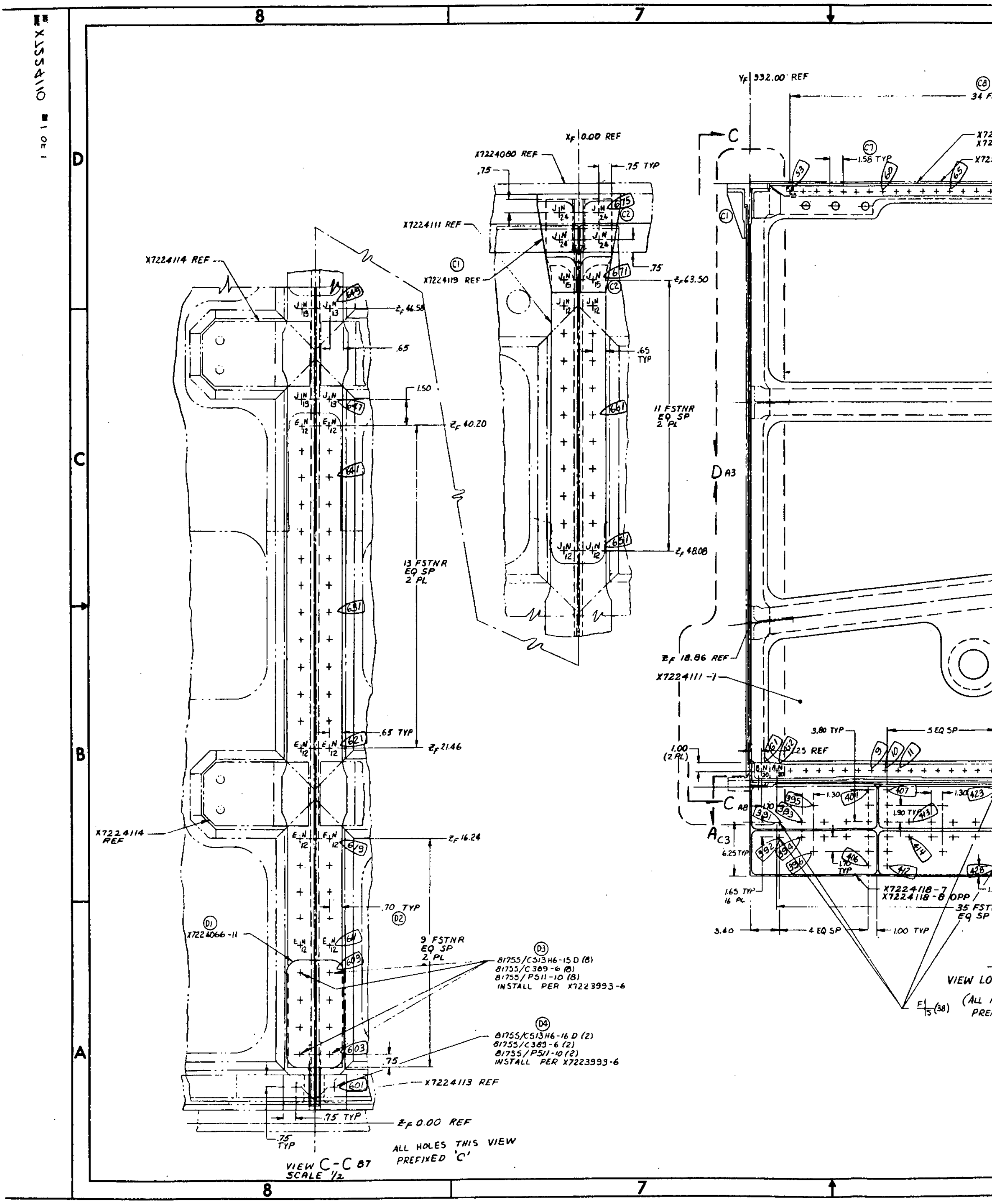


2. EVEN NUMBERS - RH SIDE
1. ALL HOLES PREFIXED 'A'
NOTES ~

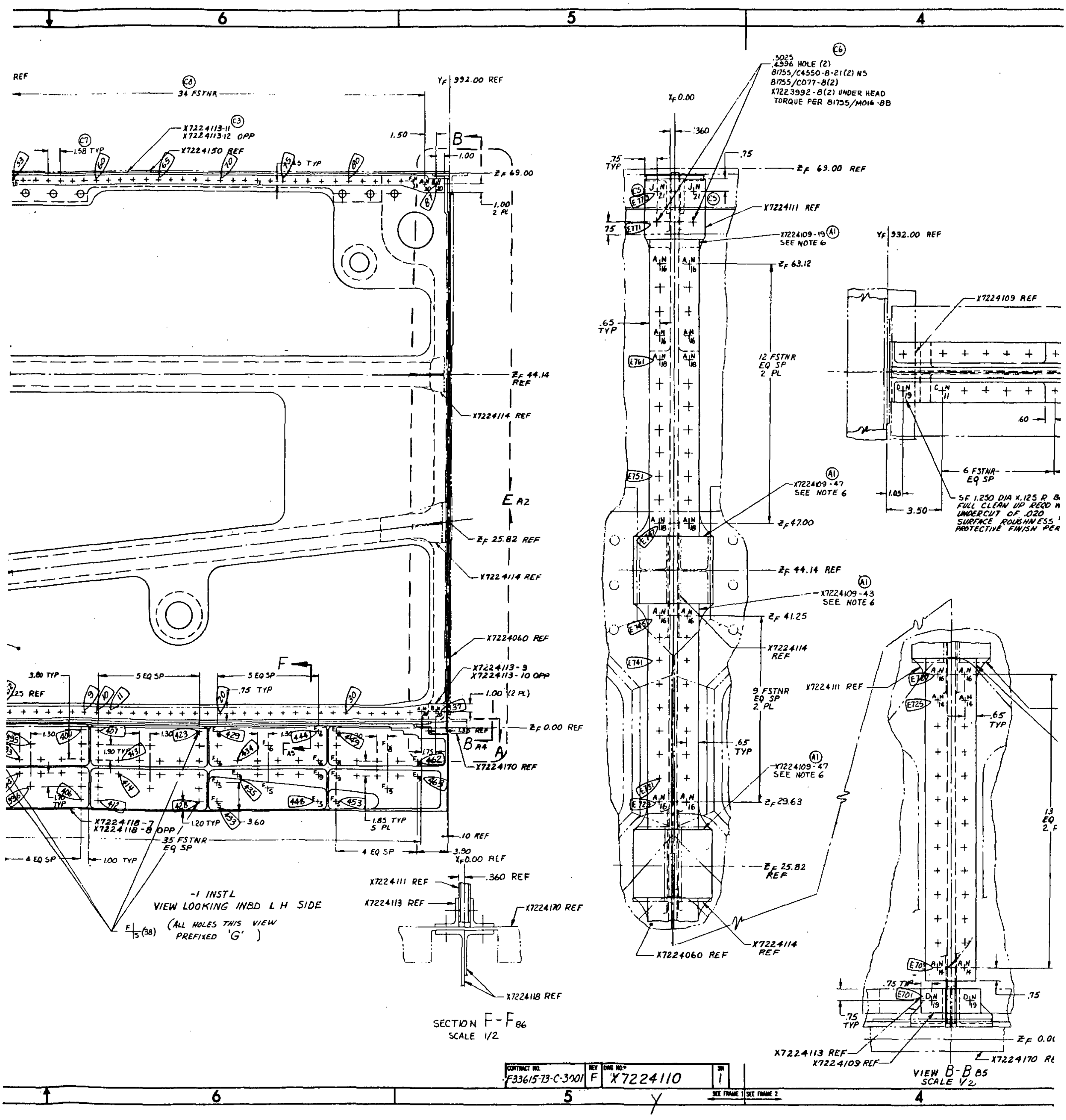
FASTENER HOLE IDENTIFICATION -
LOWER SURFACE
603H001 SH 1 OF 1
SCALE: 1/4

3

FIGURE 2.2.1-7
FASTENER HOLE IDENTIFICATION - LOWER SURFACE



VIEW C-C B7
SCALE 1/2
ALL HOLES THIS VIEW PREFIXED 'C'
X7224114 REF
X7224111 REF
X7224119 REF
X7224080 REF
X7224113 REF
X7224066-11
X7224111-1
X7224118-7
X7224118-8 OPP
Y_F 332.00 REF
X_F 0.00 REF
Z_F 0.00 REF
Z_F 18.86 REF
13 FSTNR EQ SP 2 PL
11 FSTNR EQ SP 2 PL
9 FSTNR EQ SP 2 PL
81755/C513H6-15 D (8)
81755/C389-6 (8)
81755/P511-10 (8)
INSTALL PER X7223993-6
81755/C513H6-16 D (2)
81755/C389-6 (2)
81755/P511-10 (2)
INSTALL PER X7223993-6



6
5
4
.5025
.4996 HOLE (2)
81755/C4550-8-21(2) NS
81755/C077-8(2)
X7223992-8(2) UNDER HEAD
TORQUE PER 81755/M016-8B
34 FSTNR
X7224113-11
X7224113-12 OPP
X7224150 REF
Y_F 932.00 REF
X_F 0.00
Z_F 69.00
Z_F 69.00 REF
X7224111 REF
X7224109-19
SEE NOTE 6
Z_F 63.12
12 FSTNR
EQ SP
2 PL
X7224109 REF
Z_F 44.14 REF
X7224114 REF
6 FSTNR
EQ SP
X7224109-47
SEE NOTE 6
SF 1.250 DIA X.125 R
FULL CLEAN UP REQD
UNDERCUT OF .020
SURFACE ROUGHNESS
PROTECTIVE FINISH PER
Z_F 47.00
Z_F 25.82 REF
X7224109-43
SEE NOTE 6
Z_F 41.25
X7224060 REF
X7224113-9
X7224113-10 OPP
9 FSTNR
EQ SP
2 PL
Z_F 0.00 REF
X7224170 REF
X7224118-7
X7224118-8 OPP
35 FSTNR
EQ SP
Z_F 29.63
-1 INSTL
VIEW LOOKING INBD L H SIDE
(ALL HOLES THIS VIEW PREFIXED 'G')
X7224113 REF
X7224118 REF
X7224060 REF
X7224114 REF
SECTION F - F B6
SCALE 1/2
X7224113 REF
X7224109 REF
X7224170 REF
VIEW B - B B5
SCALE 1/2
CONTRACT NO. F33615-73-C-3901
REV F
DWG NO. X7224110
SH 1
SEE FRAME 1
SEE FRAME 2

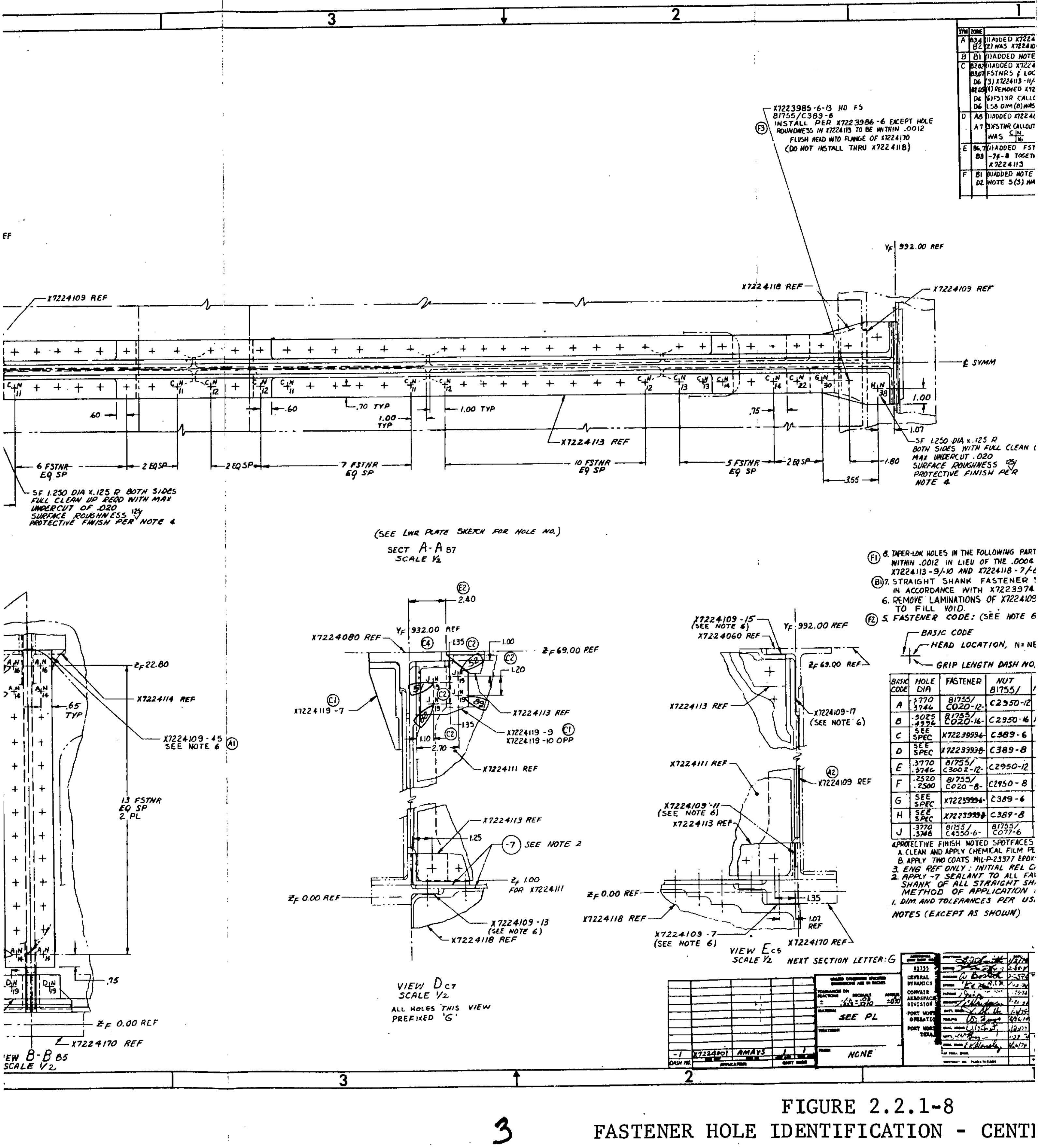


FIGURE 2.2.1-8
FASTENER HOLE IDENTIFICATION - CENT

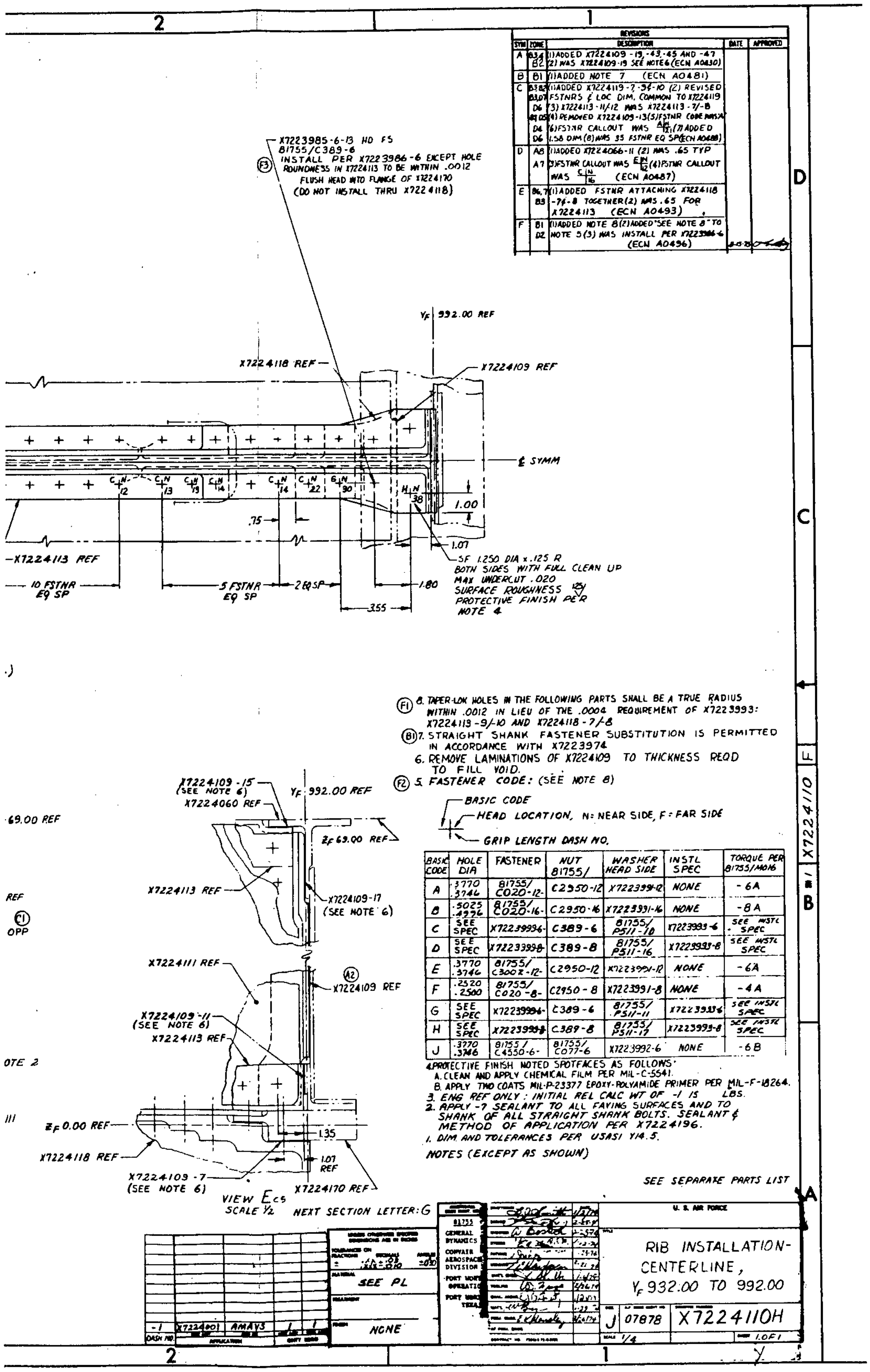
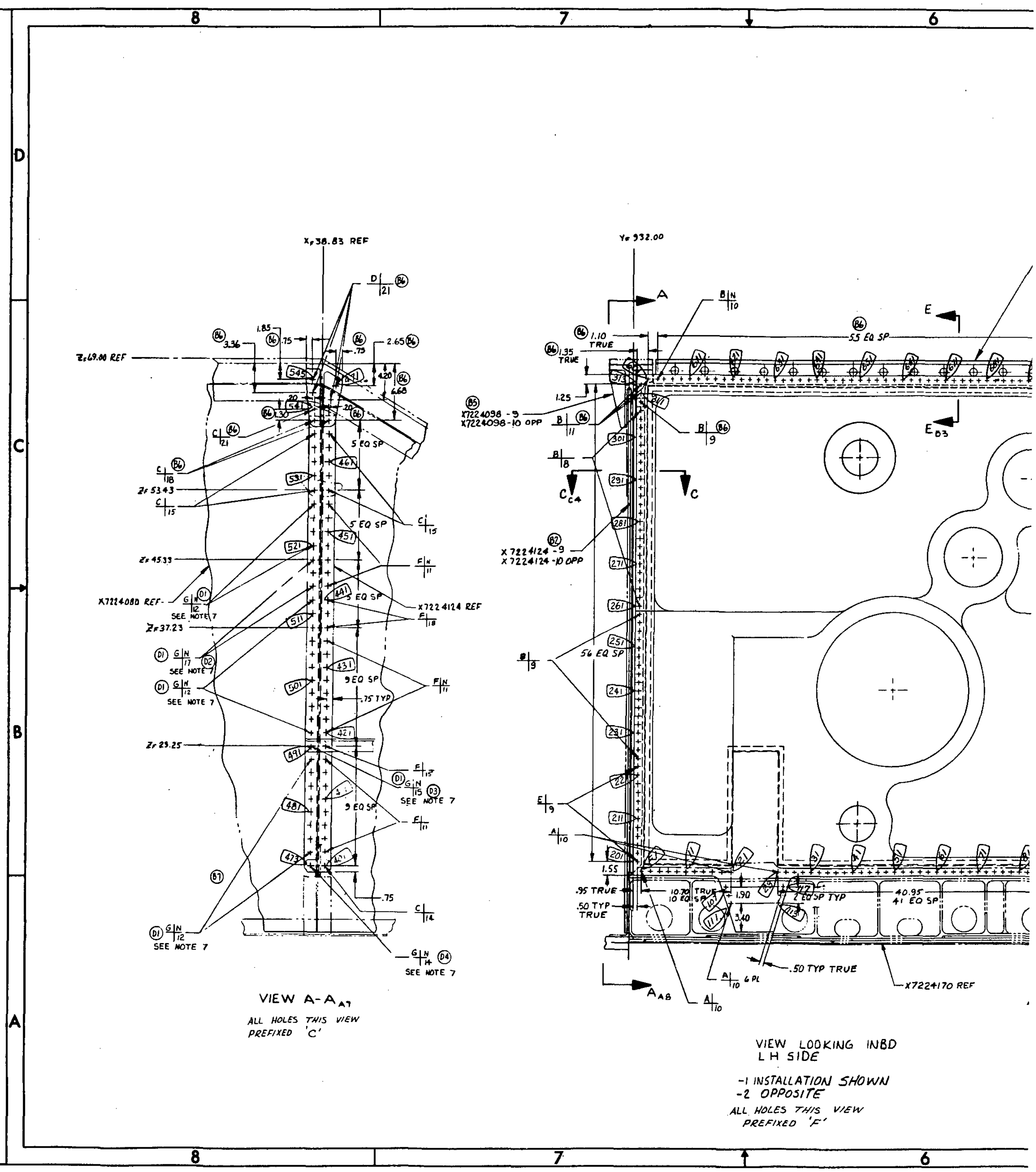
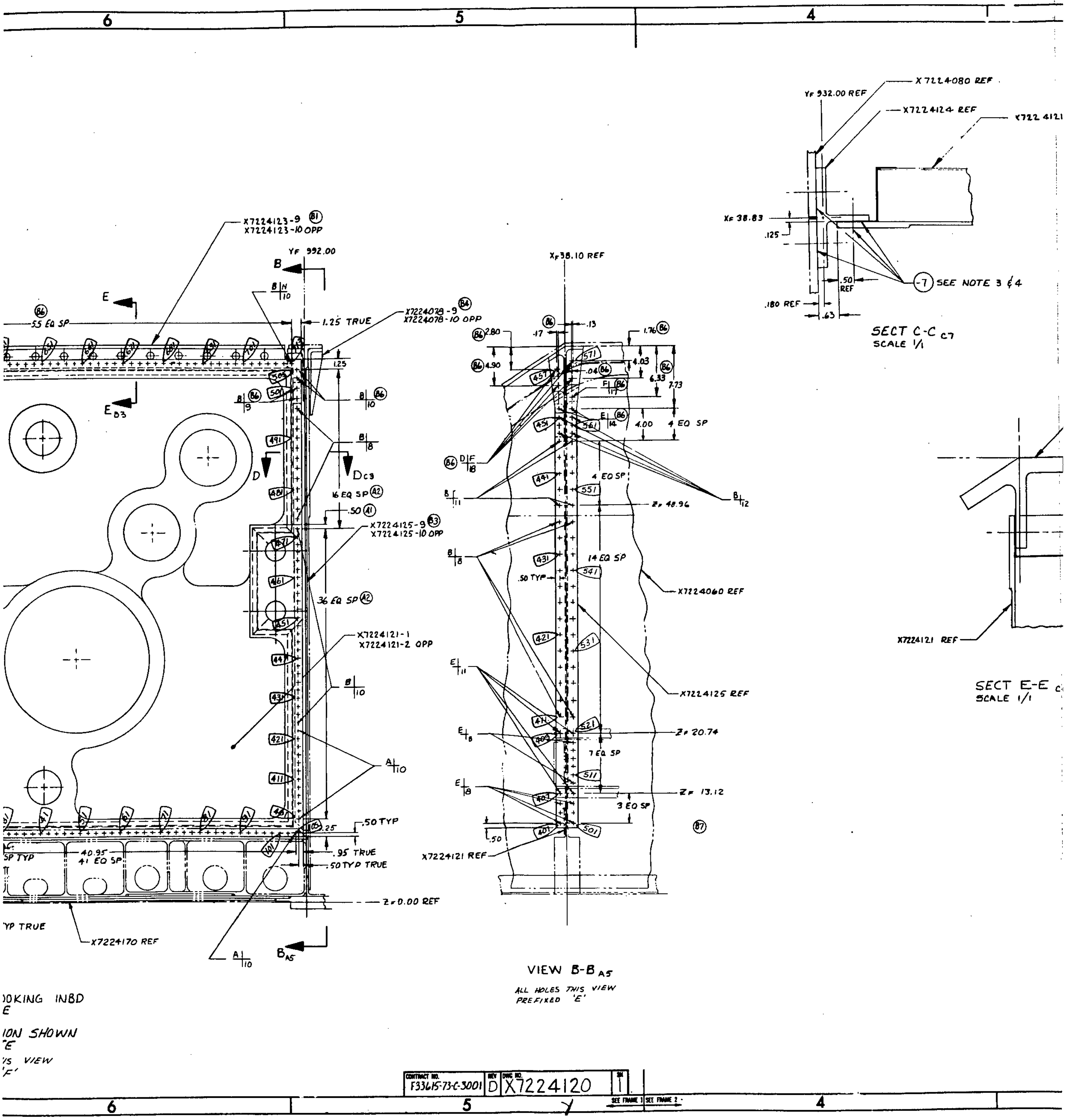


FIGURE 2.2.1-8
FASTENER HOLE IDENTIFICATION - CENTERLINE RIB

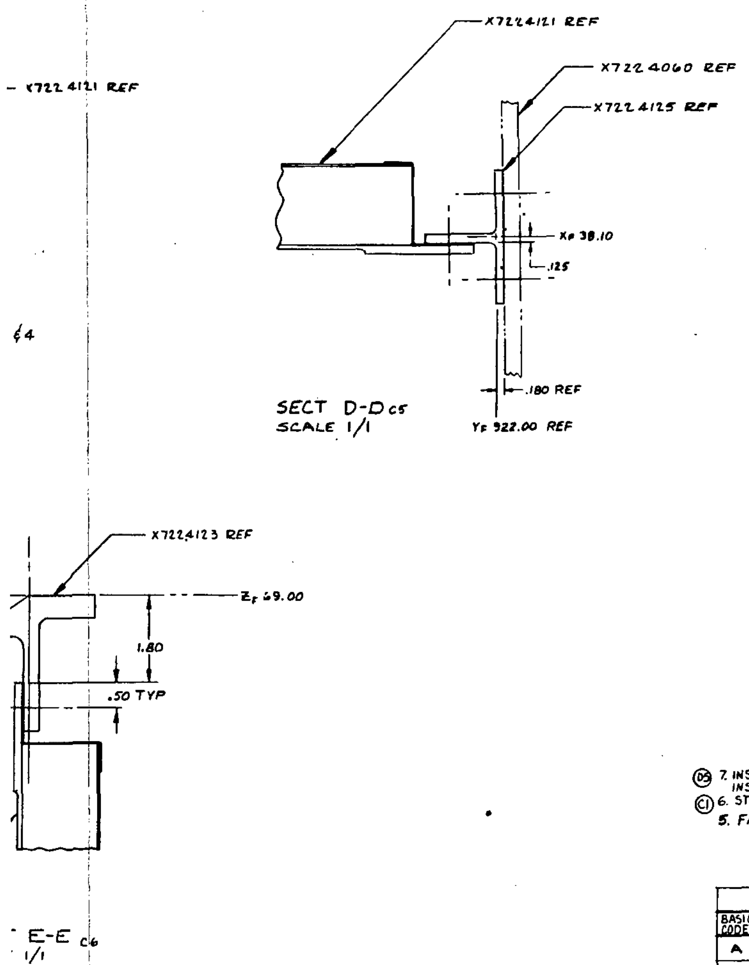
4


VIEW A-A
ALL HOLES THIS VIEW PREFIXED 'C'
VIEW LOOKING INBD LH SIDE
-1 INSTALLATION SHOWN
-2 OPPOSITE
ALL HOLES THIS VIEW PREFIXED 'F'
X7224098 -9
X7224098 -10 OPP
X 7224124 -9
X 7224124 -10 OPP
X7224124 REF
X7224080 REF
X7224170 REF
SEE NOTE 7
56 EQ SP
55 EQ SP
.50 TYP TRUE
40.95
41 EQ SP



6
5
4
X7224123-9 B1
X7224123-10 OPP
YF 992.00
1.25 TRUE
X7224078-9 B4
X7224078-10 OPP
55 EQ SP
16 EQ SP A2
.50 A1
X7224125-9 B3
X7224125-10 OPP
36 EQ SP A2
X7224121-1
X7224121-2 OPP
40.95
41 EQ SP
.50 TYP
.95 TRUE
.50 TYP TRUE
Z F 0.00 REF
X7224170 REF
YP TRUE
XF 38.10 REF
4 EQ SP
Z F 48.96
14 EQ SP
X7224060 REF
X7224125 REF
Z F 20.74
7 EQ SP
Z F 13.12
3 EQ SP
X7224121 REF
VIEW B-B A5
ALL HOLES THIS VIEW PREFIXED 'E'
X7224080 REF
X7224124 REF
YF 932.00 REF
XF 38.83
.180 REF
SEE NOTE 3 & 4
SECT C-C C7
SCALE 1/1
X7224121 REF
SECT E-E
SCALE 1/1
OOKING INBD
ION SHOWN
IS VIEW
CONTRACT NO. F33615-73-C-3001
REV D
DWG NO. X7224120
SH 1
SEE FRAME 1
SEE FRAME 2

2



REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
A	C5	(1) ADDED .50 DIM (2) REPLACED 52 EQ SP WITH 16 EQ SP & 36 EQ SP (ECN A0457		
B	D5 C7 C5 C7 A4 A8	(1) X7224123-9/-10 WAS X7224123-7/-8 (2) X7224124-9/-10 WAS X7224124-7/-8 (3) X7224125-9/-10 WAS X7224125-7/-8 (4) ADDED X7224078-9/-10 (5) ADDED X7224098-9/-10 (6) REVISED FSTNRS AND LOC DIM IN AREA OF ADDED PARTS (7) REMOVED Z_F 8.80 AND Z_F 8.30 LOC DIM FOR X7224125 AND X7224124 (ECN B0966)	6-14-74	
C	B2	(1) ADDED NOTE 6 (ECN A0482)		
D	A7,8 B7,8 B7 A7 B2	(1) 'G' FSTNR CODE WAS 'F', ADDED SEE NOTE 7 (2) 17 GRIP WAS 18 (3) 15 GRIP WAS 16 (4) 'G' FSTNR CODE WAS 'C', ADDED SEE NOTE 7 (5) ADDED NOTE 7 (6) ADDED 'G' FSTNR CODE TO NOTE 5 (ECN A1570)	3-18-75	

D5 7. INSTALL 81755/C061-064 NUTPLATES WITH MS20427M4 RIVETS, FLUSH NEAR SIDE IN X7224124. INSTALL RIVETS PER 81755/M100

C1 6. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974

5. FASTENER CODE:

BASIC CODE
HEAD LOCATION (N) NEAR SIDE, (F) FAR SIDE, NO CODE OPTIONAL
GRIP

FASTENER CODES

BASIC CODE	HOLE DIA	FASTENER	NUT	WASHER (UNDER BOLT HEAD)	WASHER (UNDER NUT)	TORQUE PER
A	.2520/.2496	81755/C3002-8	81755/C2950-8	X7223991-8	X7223989-8	81755/M016-4A
B	.2520/.2496	81755/C020-8	81755/C2950-8	X7223991-8	X7223989-8	81755/M016-4A
C	.3770/.3746	X7223996-6	81755/C077-6	X7223992-6	X7223994-6	81755/M016-6B
D	.5025/.4996	X7223996-8	81755/C077-8	X7223992-8	X7223994-8	81755/M016-8B
E	.2520/.2496	X7223980-8	81755/C2950-8	X7223991-8	X7223989-8	81755/M016-4A
F	.3770/.3746	X7223980-12	81755/C2950-12	X7223991-12	X7223989-12	81755/M016-6A
D6 G	.3770/.3746	X7223996-6	81755/C061-064	X7223992-6	NONE	81755/M016-6B

4. INSTALL ALL FASTENERS WITH -7 SEALANT PER X7224196
3. APPLY -7 SEALANT TO ALL FAYING SURFACES PER X7224196
2. ALL MACHINE SURFACES 125/
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5

NOTES (EXCEPT AS SHOWN)

SEE SEPARATE PARTS LIST

NEXT SECT LTR: F

SEE PL

NONE

GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION FORT WORTH TEXAS

U. S. AIR FORCE

RIB INSTL - X_F 39, WING CARRY THRU

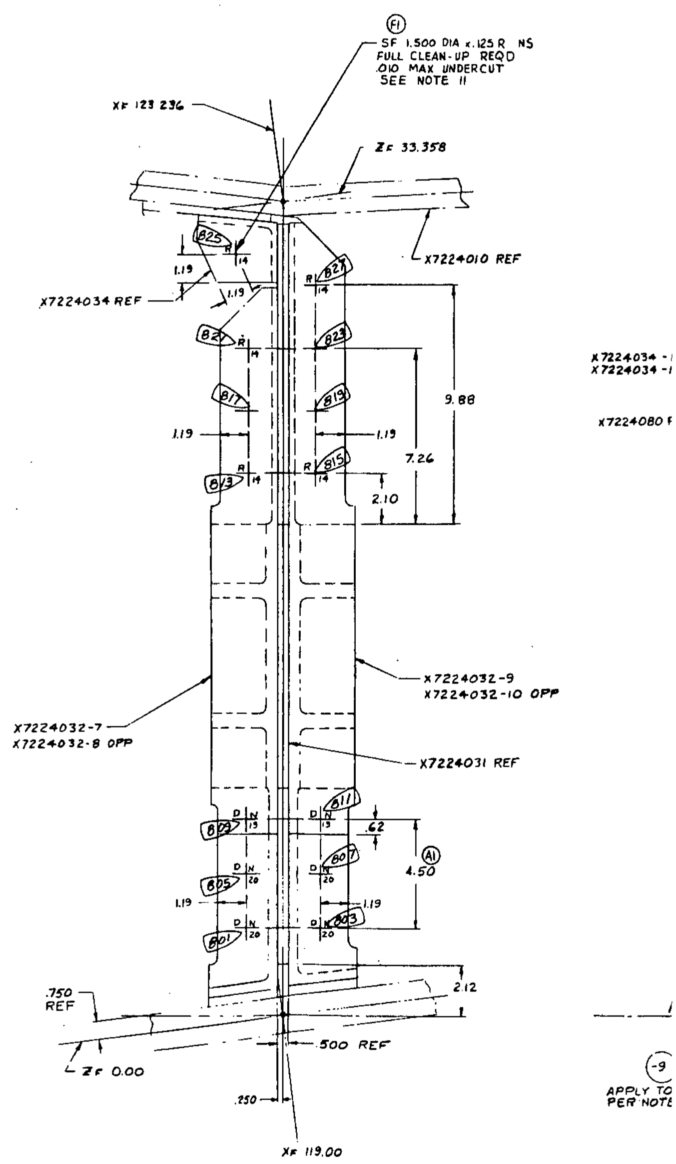
J 07878 X7224120 H

1/1 1 OF 1

DASH NO.		
-2	X7224001	AMAVS
-1	X7224001	AMAVS

3

FIGURE 2.2.1-9
FASTENER HOLE IDENTIFICATION - X_F 39 RIB

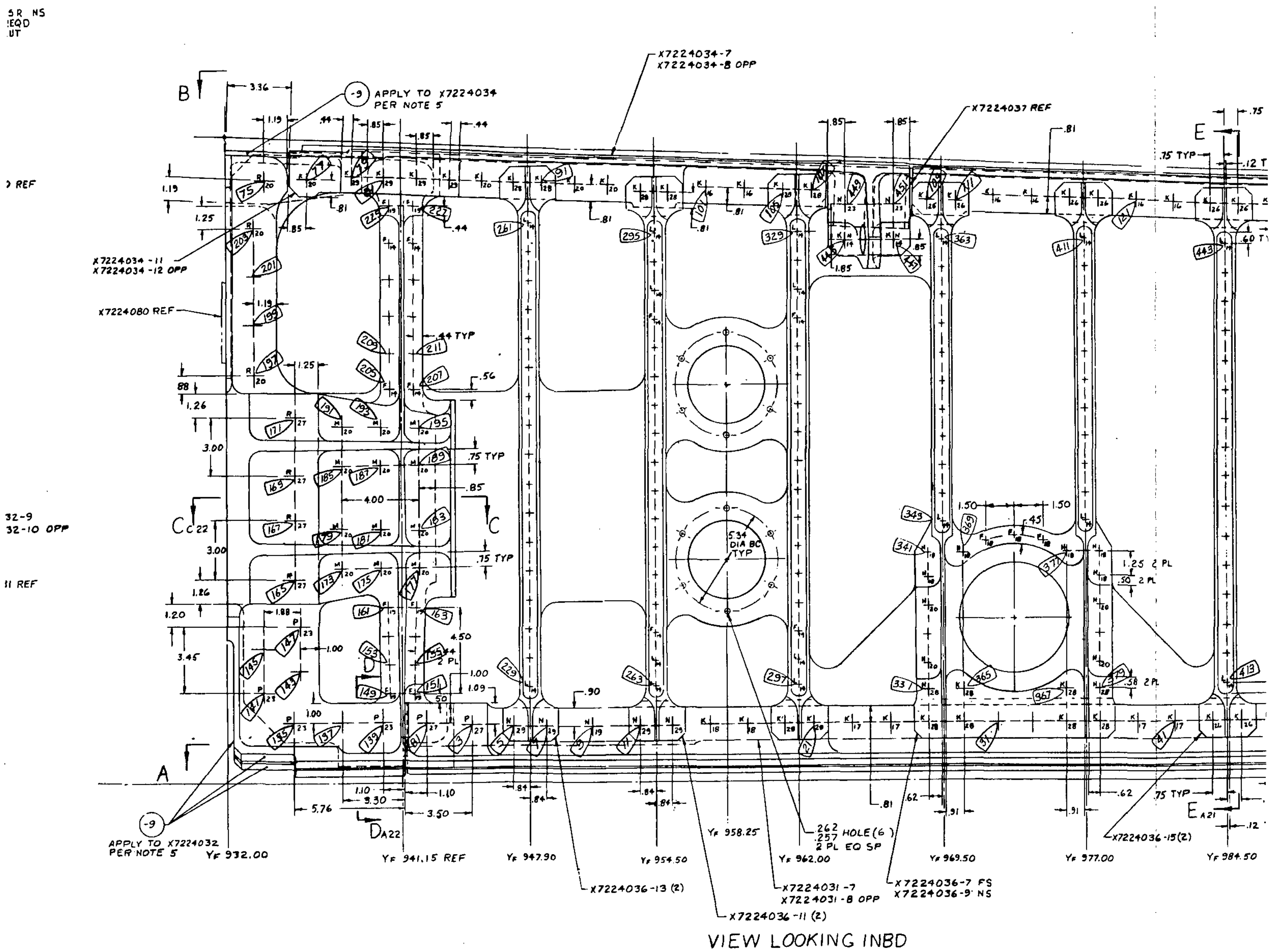


8 7 6

D C B A

XSS4030 1 of 5

6	5	4	



VIEW LOOKING INBD
NORMAL TO ℄ RIB
(ALL HOLES THIS VIEW PREFIXED 'B')

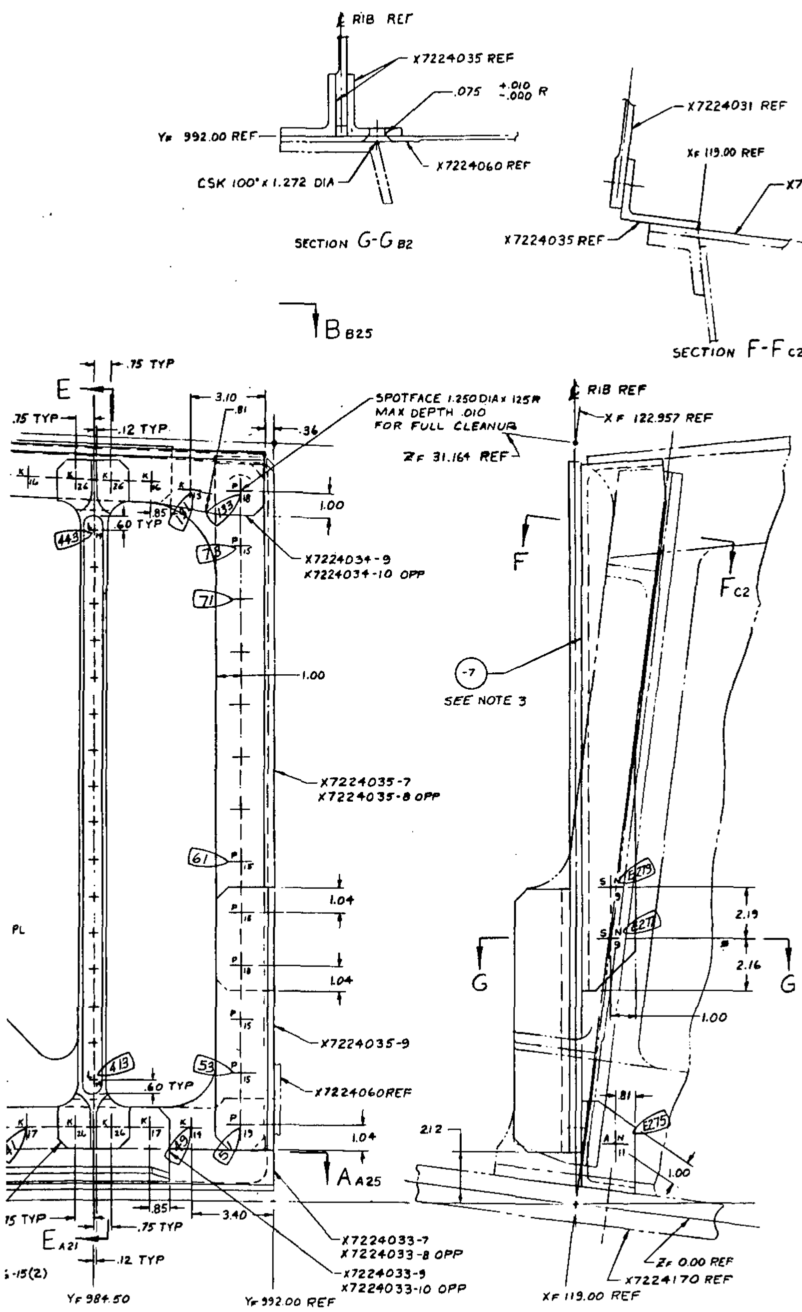
CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001	F	X7224030	1

SEE FRAME 1 | SEE FRAME 2

6	5	4	

2

SYM	ZONE	REVISIONS DESCRIPTION	DATE	APPROVED
A	B6	(1) WAS 3.50 (ECN A0443)		
B	C2	(1) ADDED NOTE 9 (ECN A0478)		
C	B2 C2	(1) .2520 WAS .2502 (ECN B1474)		
D	C2	(1) ADDED NOTE 10 (ECN A1583)		
E		REVISED SHEET 2 (ECN A1584)		
F	D6 C2	(1) ADDED SPOTFACE CALLOUT (2) ADDED NOTE 11 (ECN A1571)		



(F2) 11. PROTECTIVE FINISH NOTED SPOTFACES AS FOLLOWS:
A. CLEAN AND APPLY CHEMICAL FILM PER MIL-C-5541
B. APPLY ONE COAT MIL-P-23377 EPOXY-POLYAMIDE PRIMER PER MIL-F-18264

(D1) 10. -9 MOLDED SHIM MAY BE REPLACED WITH P103 PEEL SHIM TO FACILITATE ASSEMBLY. THE PEEL SHIM SHALL BE CUT TO SHAPE OF MATING SURFACE WITH THICKNESS SUFICIENT TO FILL VOID WITHIN .005.

(B1) 9. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974

8. FASTENER CODE:
BASIC CODE
HEAD LOCATION, (N) NEAR, (F) FAR, NO CODE OPTIONAL
GRIP LENGTH DASH NO.

	BASIC CODE	NOM DIA REF	HOLE DIA	BOLT OR PIN	NUT	WASHER, HEAD SIDE	WASHER, NUT SIDE	TORQUE	INSTL SPEC
	A	1/2	SEE SPEC	X7223999-8	81755/C389-8	81755/P5H-16	X7223986-8	SEE SPEC	X7223993-8
	B	9/16	SEE SPEC	X7223999-9	81755/C389-9	81755/P5H-19	X7223986-9	SEE SPEC	X7223993-9
	C	5/8	SEE SPEC	X7223999-10	81755/C389-10	81755/P5H-22	X7223986-10	SEE SPEC	X7223993-10
	D	3/4	SEE SPEC	X7223999-12	81755/C389-12	81755/P5H-24	X7223986-12	SEE SPEC	X7223993-12
	E	7/8	SEE SPEC	X7223999-14	81755/C389-14	81755/P5H-27	X7223986-14	SEE SPEC	X7223993-14
(C1)	F	1/4	.2520 .2496	X7223980-8	81755/C2950-8	X7223991-8	X7223989-8	81755/M016-4A	NONE
	H	3/8	.3770 .3746	X7223980-12	81755/C2950-12	X7223991-12	X7223989-12	81755/M016-6A	NONE
	K	1/2	.5025 .4996	X7223980-16	81755/C2950-16	X7223991-16	X7223989-16	81755/M016-8A	NONE
(C1)	L	1/4	.2520 .2495	81755/C020-8	81755/C2950-8	X7223991-8	X7223989-8	81755/M016-4A	NONE
	M	1/2	.5025 .4996	X7223996-8	81755/C077-8	X7223992-8	X7223994-8	81755/M016-8B	NONE
	N	9/16	.5650 .5617	X7223996-9	81755/C077-9	X7223992-9	X7223994-9	81755/M016-9B	NONE
	P	5/8	.6275 .6241	X7223996-10	81755/C077-10	X7223992-10	X7223994-10	81755/M016-10B	NONE
	R	3/4	.7525 .7491	X7223996-12	81755/C077-12	X7223992-12	X7223994-12	81755/M016-12B	NONE
	S	5/8	.6275 .6241	X7223981-10	81755/C077-10	NONE	X7223994-10	81755/M016-10B	NONE

7. -1 SHOWN, -2 OPP
6. -1/-2 CONTAIN FRACTURE CRITICAL DETAILS. RETAIN ORIGINAL DETAIL MATERIAL TRACEABILITY NUMBERS IN ACCORDANCE WITH X7224199
5. CLEAN SURFACE OF NOTED PARTS AND APPLY -9 MOLDED SHIM PER 81755/FPS-1071 CLASS II TYPE II TO FILL VOID. SEE NOTE 10.
4. ALL MACHINE SURFACES 125
3. APPLY -7 SEALANT TO ALL FAYING SURFACES AND SHANKS OF STAIGHT SHANK FASTENERS, METHOD OF APPLICATION PER X7224196
2. ALL FASTENERS EQUALLY SPACED BETWEEN END LOCATED FASTENERS, QUANTITIES AS SHOWN
1. DIMENSIONS & TOLEPANCES PER USASI Y14.5

NOTES (EXCEPT AS SHOWN)

REV STATUS	
SH	REV
1	F
2	E

SEE SEPARATE PARTS LIST

NEXT SECT LTR H

DASH NO.	APPLICATION	
-2	X7224001	AMAVS
-1	X7224001	AMAVS

MATERIAL: SEE PL

GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION FORT WORTH, TEXAS

U. S. AIR FORCE

RIB INSTL — OUTBD CLOSURE

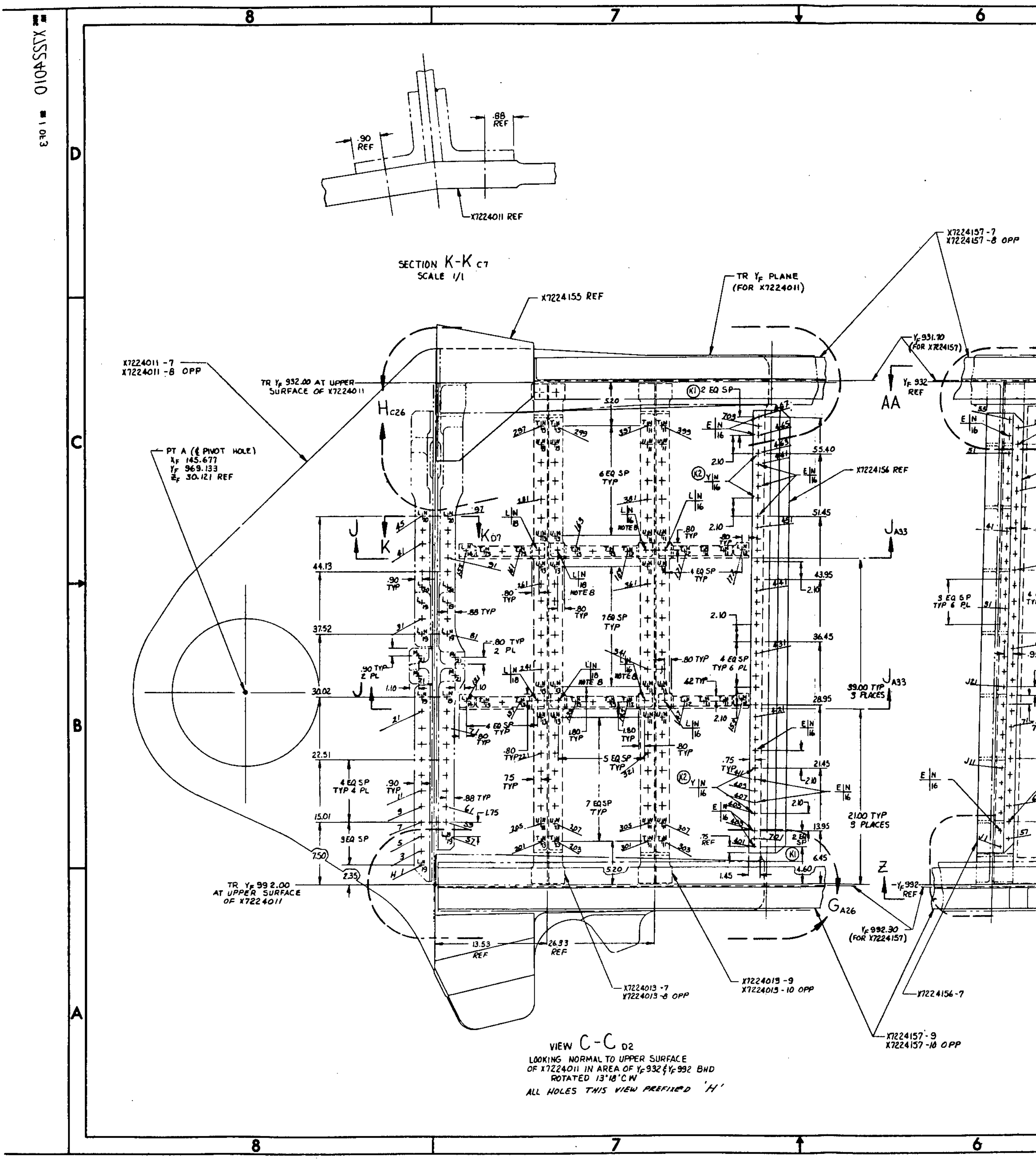
J 07878 X7224030

1/2 SHEET 1 OF 2

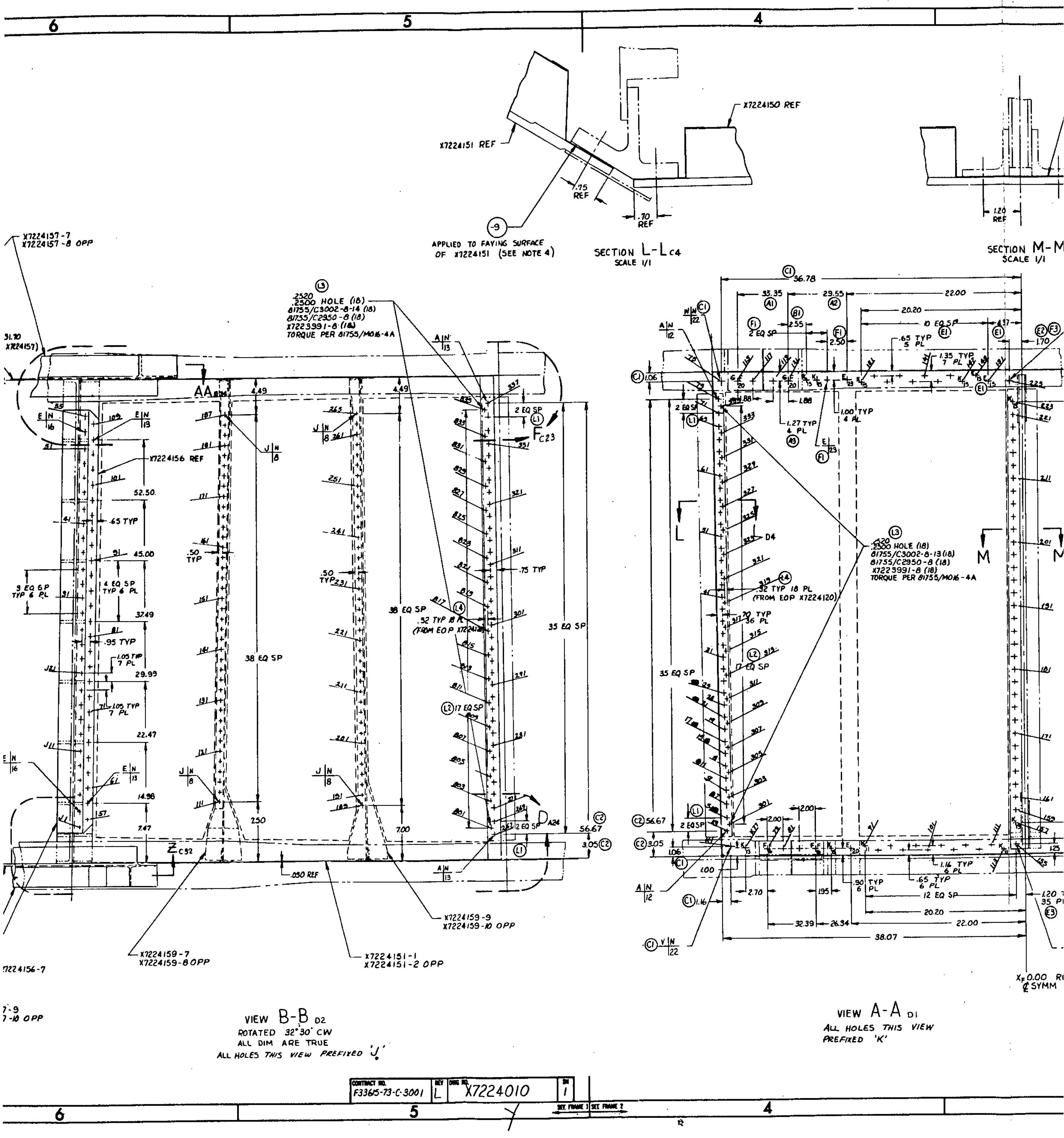
3

FIGURE 2.2.1-10
FASTENER HOLE IDENTIFICATION - CLOSURE RIB

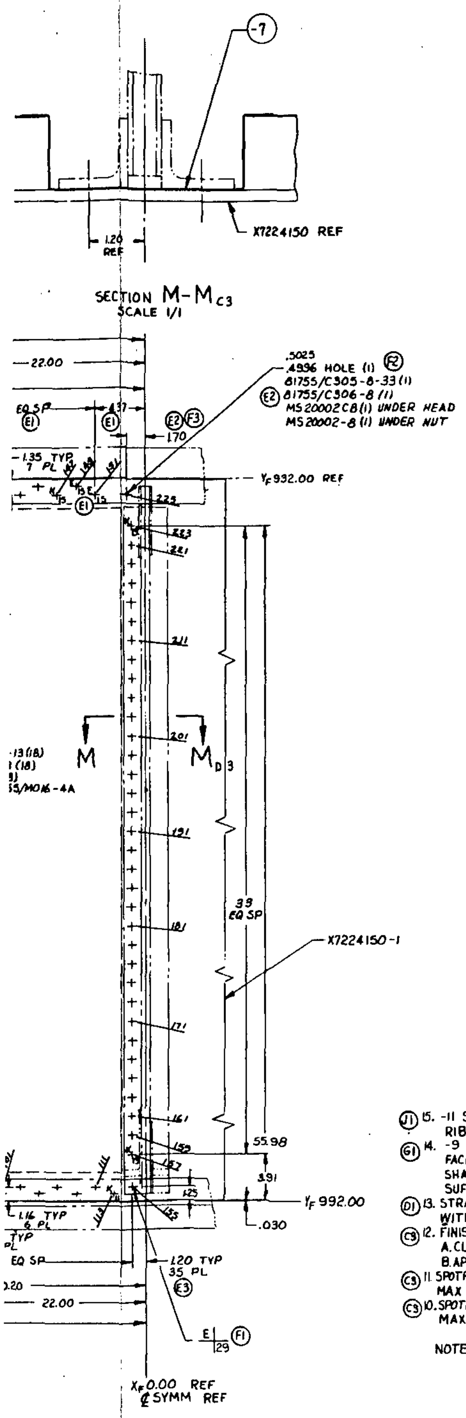
X7254010 1 OF 3

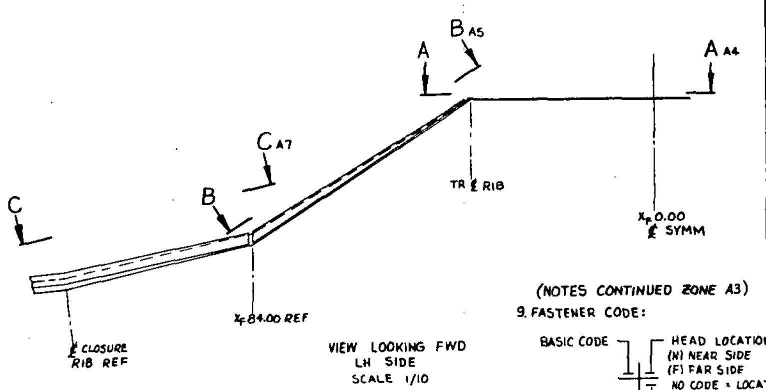


1



6
5
4
X7224151 REF
X7224150 REF
.75 REF
.70 REF
APPLIED TO FAYING SURFACE OF X7224151 (SEE NOTE 4)
SECTION L-L C4
SCALE 1/1
1.20 REF
SECTION M-M
SCALE 1/1
X7224157-7
X7224157-8 OPP
.2520
.2500 HOLE (18)
81755/C3002-8-14 (18)
81755/C2950-8 (18)
X7223991-8 (18)
TORQUE PER 81755/M016-4A
X7224156 REF
.65 TYP
4 EQ SP TYP 6 PL
9 EQ SP TYP 6 PL
.95 TYP
1.05 TYP 7 PL
38 EQ SP
35 EQ SP
2 EQ SP
.75 TYP
.52 TYP 18 PL (FROM EOP X7224120)
17 EQ SP
.050 REF
X7224159-9
X7224159-10 OPP
X7224159-7
X7224159-8 OPP
X7224151-1
X7224151-2 OPP
VIEW B-B D2
ROTATED 32°30' CW
ALL DIM ARE TRUE
ALL HOLES THIS VIEW PREFIXED 'J'
.2520
.2500 HOLE (18)
81755/C3002-8-13 (18)
81755/C2950-8 (18)
X7223991-8 (18)
TORQUE PER 81755/M016-4A
.32 TYP 18 PL (FROM EOP X7224120)
.70 TYP 36 PL
10 EQ SP
1.35 TYP 7 PL
.65 TYP 5 PL
1.27 TYP 4 PL
1.00 TYP 4 PL
1.16 TYP 6 PL
.65 TYP 6 PL
12 EQ SP
.90 TYP 6 PL
36.78
35.35
29.55
22.00
20.20
38.07
32.39
26.34
56.67
3.05
XF 0.00 REF
℄ SYMM
VIEW A-A D1
ALL HOLES THIS VIEW PREFIXED 'K'
CONTRACT NO. F33615-73-C-3001
REV L
DWG NO. X7224010
SH 1
SEE FRAME 3
SEE FRAME 2





REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED
A	C4	(1) WAS 35.60 (2) WAS 29.50 (3) 1.27 WAS 1.15 (ECN A0466)		
B	C4	(1) WAS 2.30 (ECN B0964)		
C	AC4 B4 A9 B2	(1) REV & RELOCATED FSTNRS (2) RELOCATED FSTNR (3) ADDED NOTES 10, 11 & 12 (4) ADDED FSTNR CODES V & W TO NOTE 9 (ECN A0435)		
D	A3	(1) ADDED NOTE 13 (ECN A0477)		
E	C3 C3 A9	(1) REV & RELOCATED FSTNR (2) ADDED FSTNR CALLOUT & RELOCATED (3) 35 WAS 36 (ECN B1423)		
F	ABC4 C3	(1) REV & RELOCATED FSTNR (2) 33 GRIP WAS 29 (3) WAS 1.60 (ECN A0491)		
G	B3	(1) ADDED NOTE 14 (ECN B1486)		
H		NOT INCORP - 1ST ARTICLE ONLY (ECN A1587)		
J	B3	(1) ADDED NOTE 15 (ECN A1600)		
K	ABC7 B2	(1) ADDED 2 EQ SP (2) Y FSTNR CODE WAS E (3) ADDED Y CODE TO NOTE 9 (ECN A1602)		
L	ABC45 ABC45	(1) ADDED 2 EQ SP (2) ADDED 17 EQ SP (3) ADDED FSTNR CALLOUT (4) ADDED .32 TYP 18 PL (ECN A1599)	11-5-75	

(NOTES CONTINUED ZONE A3)

9. FASTENER CODE:

BASIC CODE — HEAD LOCATION: (N) NEAR SIDE, (F) FAR SIDE, NO CODE = LOCATION OPTIONAL — GRIP LENGTH DASH NO.

	BASIC CODE	HOLE DIA	100° CSK DIA	FASTENER	NUT 81755/	WASHER UNDER HD	WASHER UNDER NUT	TORQUE PER 81755/M016
	A	.3770 .3746	.762	81755/C4551-6-	C077-6	NONE	X7223994-6	-6 B
	B	1.0025 .9991	NONE	81755/C4550-16-	C077-16	X7223992-16	X7223994-16	-16 B
	C	.2507 .2485	NONE	81755/C3002-8-	C2950-8	X7223991-8	NONE	-4 A
	D	1.0025 .9991	NONE	X7223996-16-	C077-16	X7223992-16	X7223994-16	-16 B
	E	.3770 .3746	NONE	81755/C4550-6-	C077-6	X7223992-6	X7223994-6	-6 B
	F	.5025 .4996	NONE	81755/C4550-8-	C077-8	X7223992-8	X7223994-8	-8 B
	G	.6275 .6241	NONE	81755/C4550-10-	C077-10	X7223992-10	X7223994-10	-10 B
	H	.7525 .7491	NONE	81755/C4550-12-	C077-12	X7223992-12	X7223994-12	-12 B
	J	.2507 .2485	.399	81755/C3001-8-	C2950-8	NONE	NONE	-4 A
	K	.3770 .3746	NONE	81755/C3002-12-	C2950-12	X7223991-12	NONE	-6 A
	L	.5025 .4996	NONE	X7223996-8-	C077-8	X7223992-8	X7223994-8	-8 B
	M	.5650 .5617	NONE	X7223996-9-	C077-9	X7223992-9	X7223994-9	-9 B
	N	.6275 .6241	NONE	X7223996-10-	C077-10	X7223992-10	X7223994-10	-10 B
	P	.7525 .7491	NONE	X7223996-12-	C077-12	X7223992-12	X7223994-12	-12 B
	R	.5025 .4996	1.017	X7223981-8-	C077-8	NONE	X7223994-8	-8 B
	S	.3132 .3110	.479	81755/C3001-10-	C2950-10	NONE	NONE	-5 A
	T	.3770 .3746	NONE	X7223980-12-	C2950-12	X7223991-12	X7223989-12	-6 A
	U	.3770 .3746	NONE	81755/C020-12-	C2950-12	X7223991-12	X7223989-12	-6 A
C4	V	.5025 .4996	1.017	81755/C4551-8-	C077-8	NONE	X7223994-8	-8 B
C4	W	.6275 .6241	1.272	X7223981-10-	C077-10	NONE	X7223994-10	-10 B
K3	Y	.4395 .4371	NONE	81755/C4550-7-	C077-7	X7223992-7	X7223994-7	-7 B

8. SPOTFACE NOTED HOLES 1.000 DIA X .062 R FAR SIDE WITH FULL CLEAN UP, MAX UNDERCUT .015, SURFACE ROUGHNESS 125 MAX.
7. FOR CONTOUR SEE MASTER DIMENSIONS DATA PACKAGE 43999/560101.01.
6. ALL FASTENERS TO BE INSTALLED NORMAL TO NEAR SURFACE.
5. SURFACE ROUGHNESS OF ALL FASTENER HOLES SHALL NOT EXCEED 125.
4. CLEAN NOTED FAYING SURFACES AND APPLY -9 MOLDED SHIM PER 81755/FPS-1071 CLASS II, TYPE II.
3. SEALING MATERIALS AND METHODS OF APPLICATIONS PER X7224196.
2. APPLY -7 GENERAL SEALANT TO ALL FAYING SURFACES AND TO SHANK OF ALL FASTENERS.
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5

NOTES (EXCEPT AS SHOWN)

(J1) 15. -11 SHOWN IN FLAT PATTERN. FORM TO SHAPE OF BULKHEAD AND RIB AT INSTALLATION. BEND RADIUS TO BE .12 ±.10

(G1) 14. -9 MOLDED SHIM MAY BE REPLACED WITH 81755/P103 PEEL SHIM TO FACILITATE ASSEMBLY IN NOTED LOCATIONS ONLY. THE PEEL SHIM SHALL BE CUT TO SHAPE OF MATING SURFACE WITH THICKNESS SUFFICIENT TO FILL VOID WITHIN .005

(D1) 13. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974

(C9) 12. FINISH NOTED SPOTFACES AS FOLLOWS:
A. CLEAN AND APPLY CHEMICAL FILM PER MIL-C-5541
B. APPLY ONE COAT MIL-P-23377 EPOXY-POLYAMIDE PRIMER PER MIL-F-18264

(C9) 11. SPOTFACE NOTED HOLES 1.375 DIA x .125 R FAR SIDE WITH FULL CLEAN-UP, MAX UNDERCUT .015, SURFACE ROUGHNESS 125 MAX

(C9) 10. SPOTFACE NOTED HOLES 1.500 DIA x .125 R FAR SIDE WITH FULL CLEAN-UP, MAX UNDERCUT .015, SURFACE ROUGHNSS 125 MAX

NOTES ~ CONTINUED

REV STATUS	
SH	REV
1	L
2	J
3	J

SEE SEPARATE PARTS LIST

NEXT SECTION LETTER: AC

GENERAL DYNAMICS
CONVAIR AEROSPACE DIVISION
FORT WORTH OPERATION
FORT WORTH TEXAS

U. S. AIR FORCE

COVER INSTL
UPPER -
Y_F 932 TO Y_F 992

J 07878 X7224010H

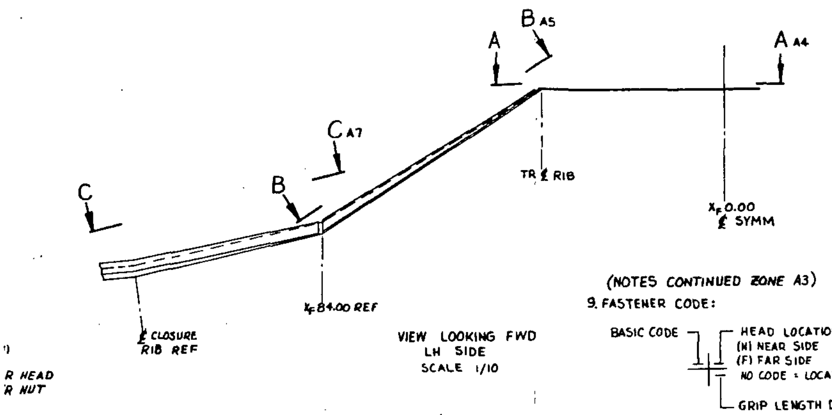
SCALE 1/4 SHEET 1 OF 3

SEE PL

NONE

-1 X7224001 AMAVS

FIGURE 2.2.1-11, SHEET 1 OF 3
FASTENER HOLE IDENTIFICATION - UPPER COVER



REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
A	C4	(1) WAS 35.60 (2) WAS 29.30 (3) 1.27 WAS 1.15 (ECN A0466)		
B	C4	(1) WAS 2.30 (ECN B0964)		
C	A C4 B4 A3 B2	(1) REV & RELOCATED FSTNRS (2) RELOCATED FSTNR (3) ADDED NOTES 10, 11 & 12 (4) ADDED FSTNR CODES V & W TO NOTE 9 (ECN A0435)		
D	A3	(1) ADDED NOTE 13 (ECN A0477)		
E	C3 C3 A3	(1) REV & RELOCATED FSTNR (2) ADDED FSTNR CALLOUT & RELOCATED (3) 35 WAS 36 (ECN B1423)		
F	A C4 C3	(1) REV & RELOCATED FSTNR (2) 33 GRIP WAS 29 (3) WAS 1.60 (ECN A0491)		
G	B3	(1) ADDED NOTE 14 (ECN B1486)		
H		NOT INCORP - 1ST ARTICLE ONLY (ECN A1587)		
J	B3	(1) ADDED NOTE 15 (ECN A1600)		
K	A C7 B2	(1) ADDED 2 EQ SP (2) Y FSTNR CODE WAS E (3) ADDED Y CODE TO NOTE 9 (ECN A1602)		
L	A C4,5 A C4,5	(1) ADDED 2 EQ SP (2) ADDED 17 EQ SP (3) ADDED FSTNR CALLOUT (4) ADDED .32 TYP 18 PL (ECN A1599)	4-3-75	

(NOTES CONTINUED ZONE A3)

9. FASTENER CODE:

BASIC CODE — HEAD LOCATION
(N) NEAR SIDE
(F) FAR SIDE
NO CODE = LOCATION OPTIONAL
— GRIP LENGTH DASH NO.

	BASIC CODE	HOLE DIA	100°CSK DIA	FASTENER	NUT 81755/	WASHER UNDER HD	WASHER UNDER NUT	TORQUE PER 81755/M016
	A	.3770 .3746	.762	81755/C4551-6-	C077-6	NONE	X7223994-6	-6 B
	B	1.0025 .9991	NONE	81755/C4550-16-	C077-16	X7223992-16	X7223994-16	-16 B
	C	.2507 .2485	NONE	81755/C3002-8-	C2950-8	X7223991-8	NONE	-4 A
	D	1.0025 .9991	NONE	X7223996-16-	C077-16	X7223992-16	X7223994-16	-16 B
	E	.3770 .3746	NONE	81755/C4550-6-	C077-6	X7223992-6	X7223994-6	-6 B
	F	.5025 .4996	NONE	81755/C4550-8-	C077-8	X7223992-8	X7223994-8	-8 B
	G	.6275 .6241	NONE	81755/C4550-10-	C077-10	X7223992-10	X7223994-10	-10 B
	H	.7525 .7491	NONE	81755/C4550-12-	C077-12	X7223992-12	X7223994-12	-12 B
	J	.2507 .2485	.999	81755/C3001-8-	C2950-8	NONE	NONE	-4 A
	K	.3770 .3746	NONE	81755/C3002-12-	C2950-12	X7223991-12	NONE	-6 A
	L	.5025 .4996	NONE	X7223996-8-	C077-8	X7223992-8	X7223994-8	-8 B
	M	.5650 .5617	NONE	X7223996-9-	C077-9	X7223992-9	X7223994-9	-9 B
	N	.6275 .6241	NONE	X7223996-10-	C077-10	X7223992-10	X7223994-10	-10 B
	P	.7525 .7491	NONE	X7223996-12-	C077-12	X7223992-12	X7223994-12	-12 B
	R	.5025 .4996	1.017	X7223981-8-	C077-8	NONE	X7223994-8	-8 B
	S	.3132 .3110	.479	81755/C3001-10-	C2950-10	NONE	NONE	-5 A
	T	.3770 .3746	NONE	X7223980-12-	C2950-12	X7223991-12	X7223989-12	-6 A
	U	.3770 .3746	NONE	81755/C020-12-	C2950-12	X7223991-12	X7223989-12	-6 A
C4	V	.5025 .4996	1.017	81755/C4551-8-	C077-8	NONE	X7223994-8	-8 B
C4	W	.6275 .6241	1.272	X7223981-10-	C077-10	NONE	X7223994-10	-10 B
K3	Y	.4395 .4371	NONE	81755/C4550-7-	C077-7	X7223992-7	X7223994-7	-7 B

8. SPOTFACE NOTED HOLES 1.000 DIA X .062 R FAR SIDE WITH FULL CLEAN UP, MAX UNDERCUT .015, SURFACE ROUGHNESS 125√ MAX.
7. FOR CONTOUR SEE MASTER DIMENSIONS DATA PACKAGE 43999/560101.01.
6. ALL FASTENERS TO BE INSTALLED NORMAL TO NEAR SURFACE.
5. SURFACE ROUGHNESS OF ALL FASTENER HOLES SHALL NOT EXCEED 125√.
4. CLEAN NOTED FAYING SURFACES AND APPLY -9 MOLDED SHIM PER 81755/FPS-1071 CLASS II, TYPE II.
3. SEALING MATERIALS AND METHODS OF APPLICATIONS PER X7224196.
2. APPLY -7 GENERAL SEALANT TO ALL FAYING SURFACES AND TO SHANK OF ALL FASTENERS.
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5

NOTES (EXCEPT AS SHOWN)

J1 15. -11 SHOWN IN FLAT PATTERN. FORM TO SHAPE OF BULKHEAD AND RIB AT INSTALLATION. BEND RADIUS TO BE .12 ±.10

G1 14. -9 MOLDED SHIM MAY BE REPLACED WITH 81755/P103 PEEL SHIM TO FACILITATE ASSEMBLY IN NOTED LOCATIONS ONLY. THE PEEL SHIM SHALL BE CUT TO SHAPE OF MATING SURFACE WITH THICKNESS SUFFICIENT TO FILL VOID WITHIN .005

D1 13. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974

C3 12. FINISH NOTED SPOTFACES AS FOLLOWS:
A. CLEAN AND APPLY CHEMICAL FILM PER MIL-C-5541
B. APPLY ONE COAT MIL-P-23377 EPOXY-POLYAMIDE PRIMER PER MIL-F-18264

C3 11. SPOTFACE NOTED HOLES 1.375 DIA x .125 R FAR SIDE WITH FULL CLEAN-UP, MAX UNDERCUT .015, SURFACE ROUGHNESS 125√ MAX

C3 10. SPOTFACE NOTED HOLES 1.500 DIA x .125 R FAR SIDE WITH FULL CLEAN-UP, MAX UNDERCUT .015, SURFACE ROUGHNSS 125√ MAX

NOTES ~ CONTINUED

REV STATUS	
SH	REV
1	L
2	J
3	J

SEE SEPARATE PARTS LIST

NEXT SECTION LETTER: AC

DASH NO.	APPLICATION		
-1	X7224001	AMAV5	

MATERIAL: SEE PL

FINISH: NONE

81755 GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION FORT WORTH TEXAS

U. S. AIR FORCE

COVER INSTL UPPER - Y_F 932 TO Y_F 992

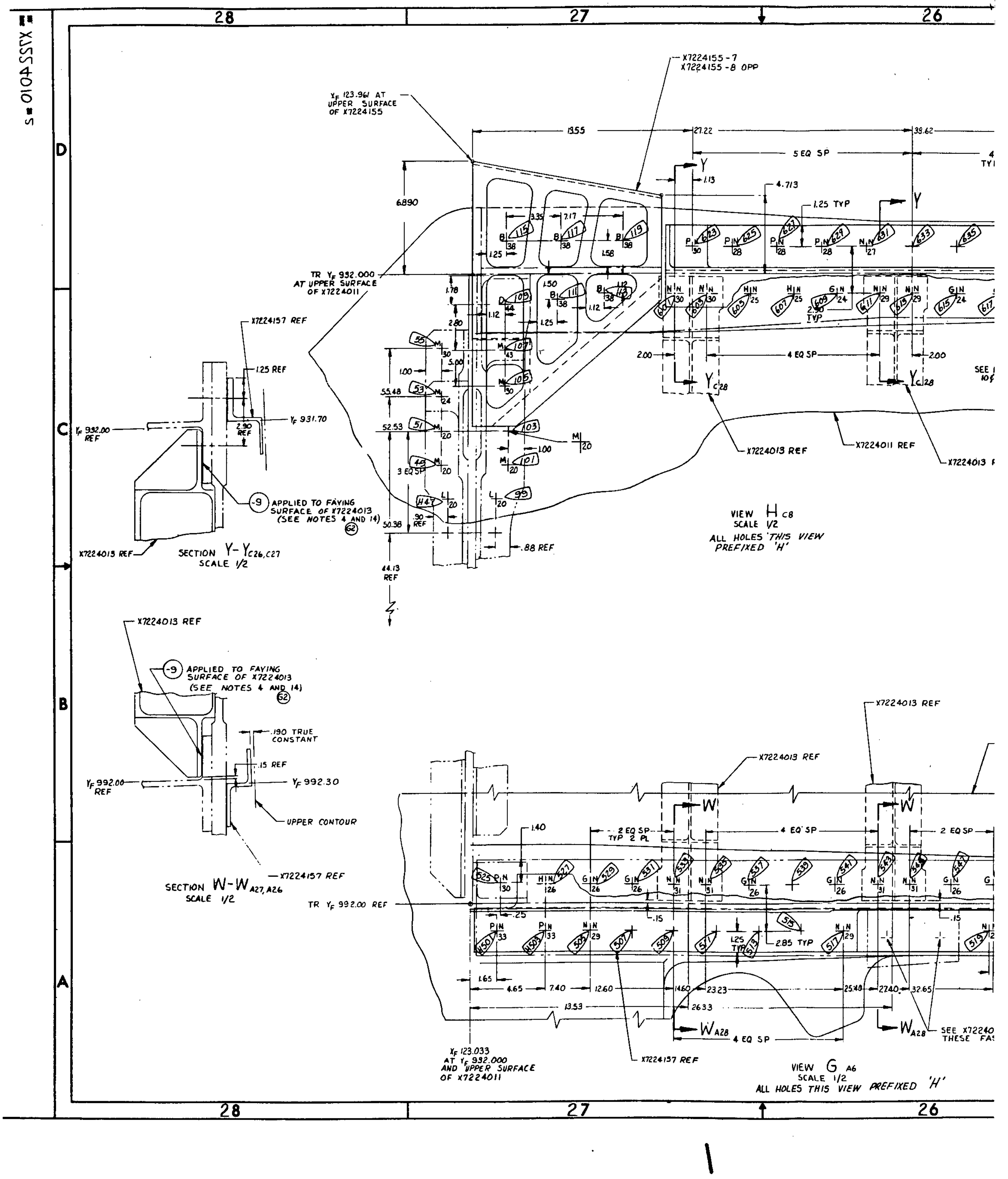
J 07878 X7224010H

SCALE 1/4 SHEET 1 OF 3

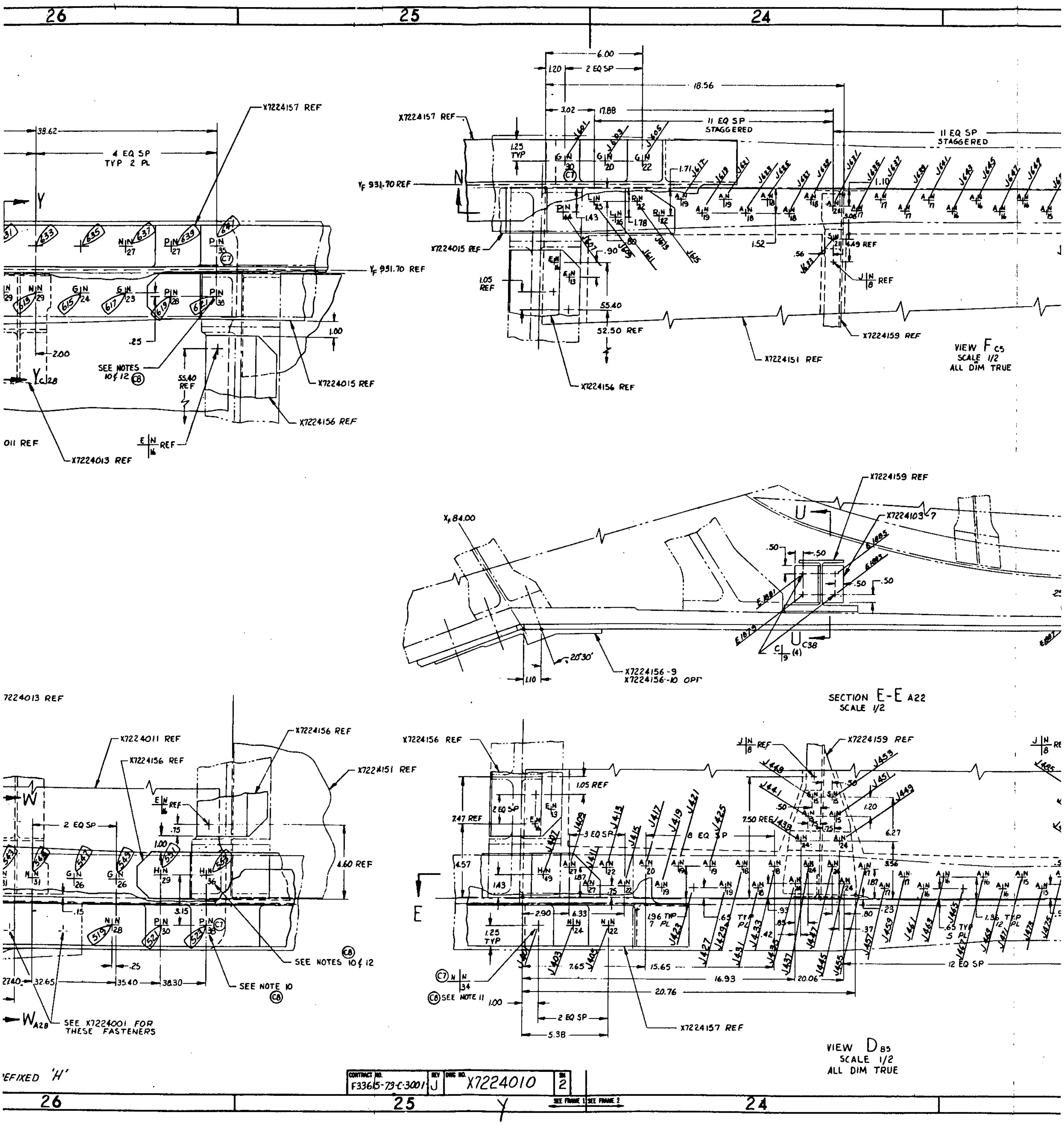
FIGURE 2.2.1-11, SHEET 1 OF 3
FASTENER HOLE IDENTIFICATION - UPPER COVER

3

X7224010 S

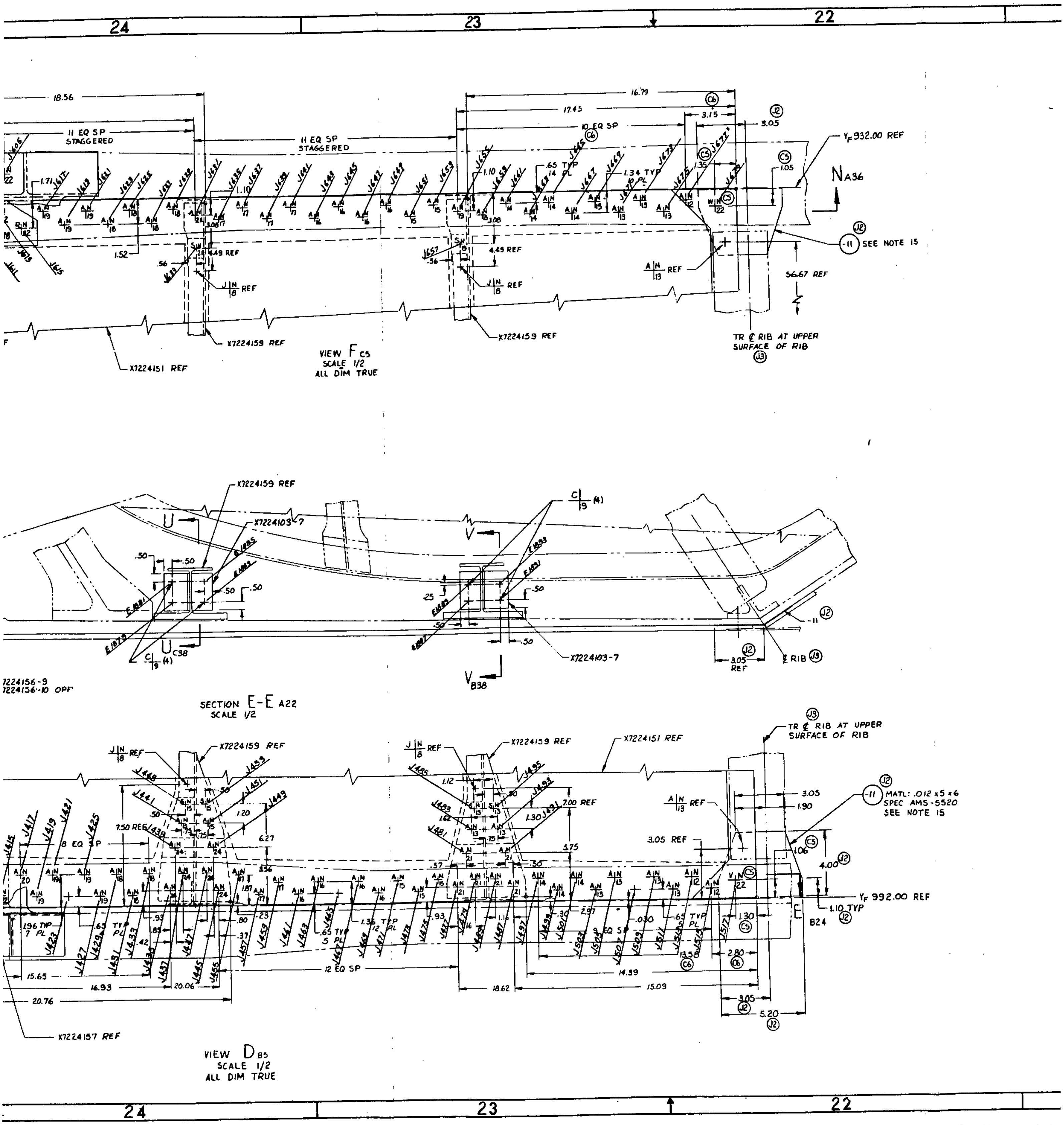


28
27
26
D
C
B
A
X7224155-7
X7224155-8 OPP
X_F 123.961 AT UPPER SURFACE OF X7224155
13.55
27.22
39.62
5 EQ SP
6.890
4.713
1.25 TYP
1.13
TR Y_F 932.000 AT UPPER SURFACE OF X7224011
X7224157 REF
1.25 REF
Y_F 932.00 REF
2.90 REF
Y_F 931.70
-9 APPLIED TO FAYING SURFACE OF X7224013 (SEE NOTES 4 AND 14)
62
X7224013 REF
SECTION Y-$Y_{C26,C27}$
SCALE 1/2
55.48
52.53
50.38
44.13 REF
3 EQ SP
.90 REF
.88 REF
1.00
5.00
2.80
1.78
1.12
1.50
1.25
1.58
3.35
7.17
2.00
4 EQ SP
2.50 TYP
X7224013 REF
X7224011 REF
VIEW H C8
SCALE 1/2
ALL HOLES THIS VIEW PREFIXED 'H'
X7224013 REF
-9 APPLIED TO FAYING SURFACE OF X7224013 (SEE NOTES 4 AND 14)
62
.190 TRUE CONSTANT
.15 REF
Y_F 992.00 REF
Y_F 992.30
UPPER CONTOUR
X7224157 REF
SECTION W-$W_{A27,A26}$
SCALE 1/2
TR Y_F 992.00 REF
1.40
2 EQ SP TYP 2 PL
4 EQ SP
2 EQ SP
.25
.15
1.25 TYP
2.85 TYP
1.65
4.65
7.40
12.60
14.60
23.23
25.40
27.40
32.65
26.33
13.53
W_{A28}
4 EQ SP
X_F 123.033 AT Y_F 932.000 AND UPPER SURFACE OF X7224011
X7224157 REF
VIEW G A6
SCALE 1/2
ALL HOLES THIS VIEW PREFIXED 'H'
SEE X72240 THESE FA



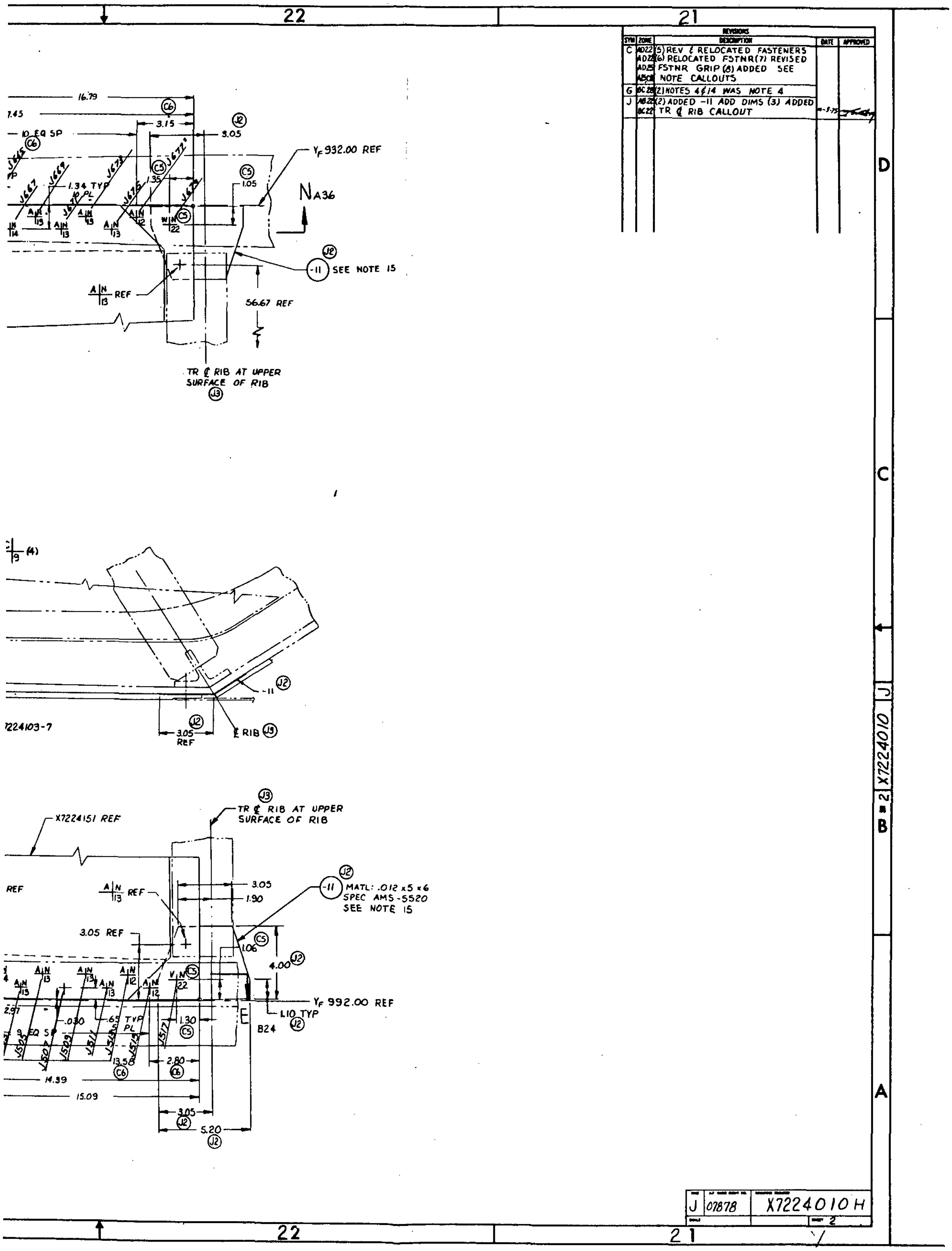
26
25
24
X7224157 REF
Y_F 931.70 REF
X7224015 REF
X7224151 REF
X7224159 REF
X7224156 REF
X7224013 REF
X7224011 REF
11 EQ SP STAGGERED
4 EQ SP TYP 2 PL
SEE NOTES 10 & 12
VIEW F C5 SCALE 1/2 ALL DIM TRUE
X_F 84.00
X7224103-7
X7224156-9
X7224156-10 OPP
SECTION E-E A22 SCALE 1/2
SEE NOTE 10
SEE NOTE 11
SEE X7224001 FOR THESE FASTENERS
12 EQ SP
VIEW D B5 SCALE 1/2 ALL DIM TRUE
PREFIXED 'H'
CONTRACT NO. F33615-73-C-3001
REV J
DWG NO. X7224010
SH 2
SEE FRAME 1
SEE FRAME 2

2



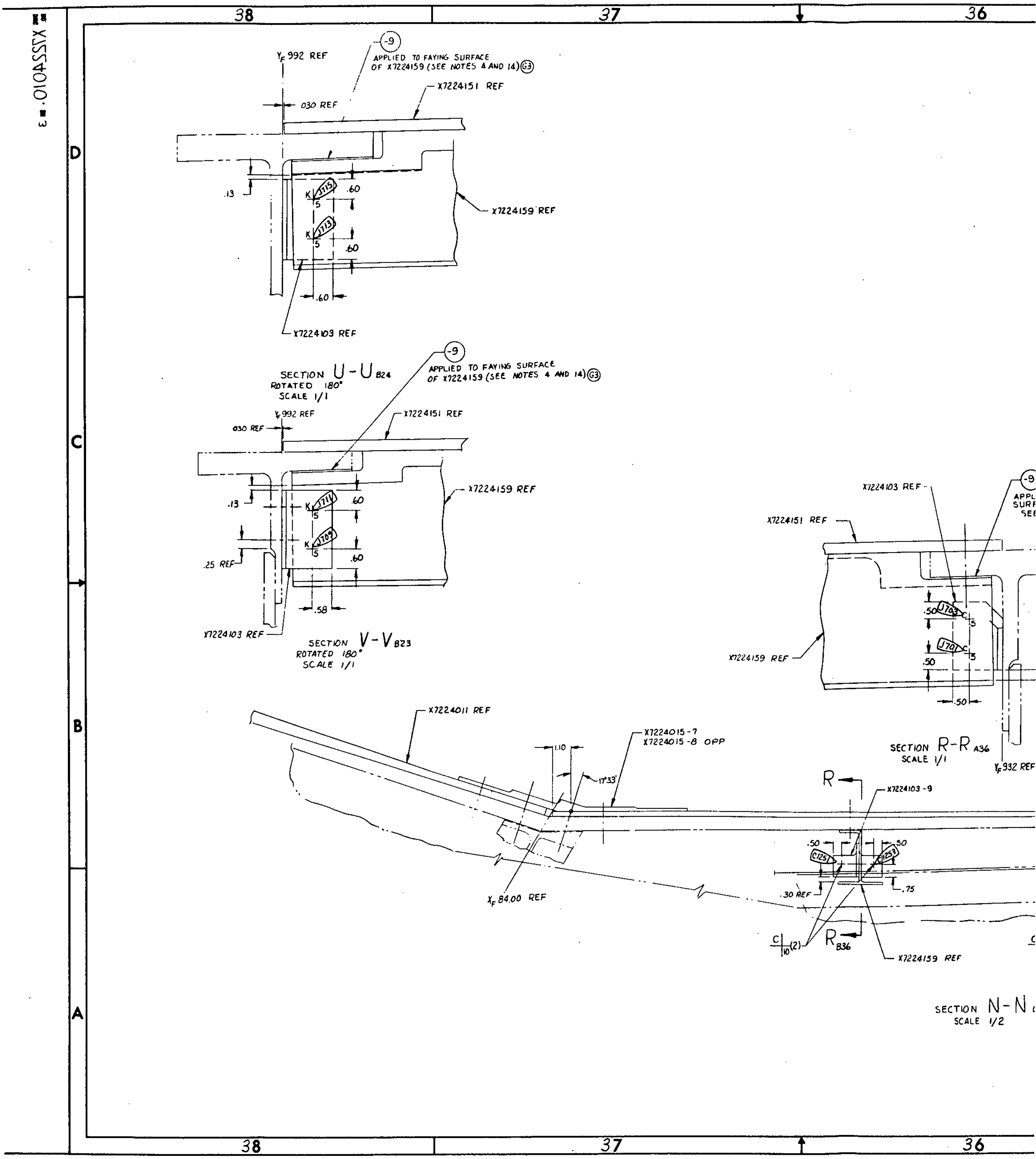
3

FIGURE 2.2.1-11
FASTENER HOLE IDENTIFI



4

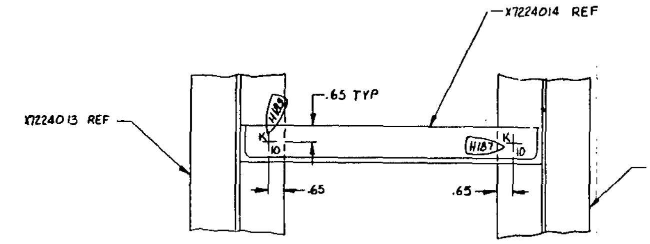
FIGURE 2.2.1-11, SHEET 2 OF 3
FASTENER HOLE IDENTIFICATION - UPPER COVER



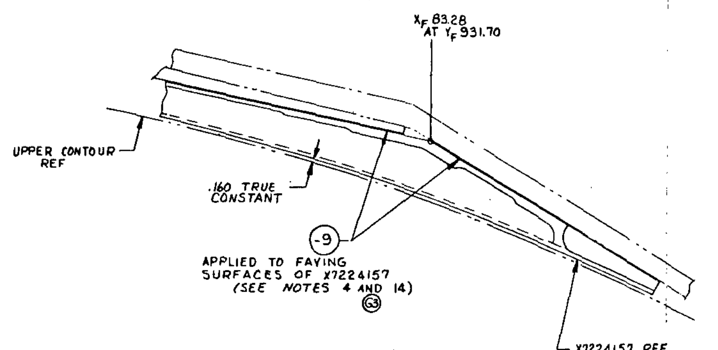
38
37
36
D
C
B
A
Y_F 992 REF
-9
APPLIED TO FAYING SURFACE OF X7224159 (SEE NOTES 4 AND 14) G3
X7224151 REF
.030 REF
.13
.60
.60
.60
X7224159 REF
X7224103 REF
SECTION U-U B24
ROTATED 180°
SCALE 1/1
-9
APPLIED TO FAYING SURFACE OF X7224159 (SEE NOTES 4 AND 14) G3
Y_F 992 REF
X7224151 REF
.030 REF
X7224159 REF
.13
.60
.60
.25 REF
.58
X7224103 REF
SECTION V-V B23
ROTATED 180°
SCALE 1/1
X7224103 REF
X7224151 REF
X7224159 REF
.50
.50
.50
SECTION R-R A36
SCALE 1/1
Y_F 932 REF
X7224011 REF
X7224015-7
X7224015-8 OPP
1.10
17°33'
R
X7224103-9
.50
.50
.30 REF
.75
X_F 84.00 REF
R B36
X7224159 REF
SECTION N-N
SCALE 1/2

X7225A010 · 3

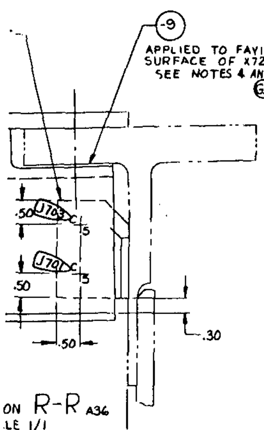
36	35	34	



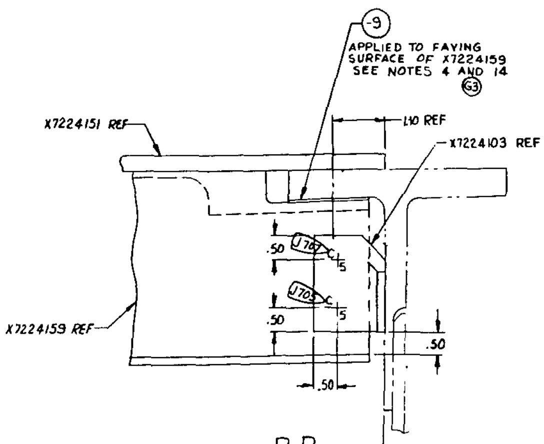
SECTION AB-AB A32



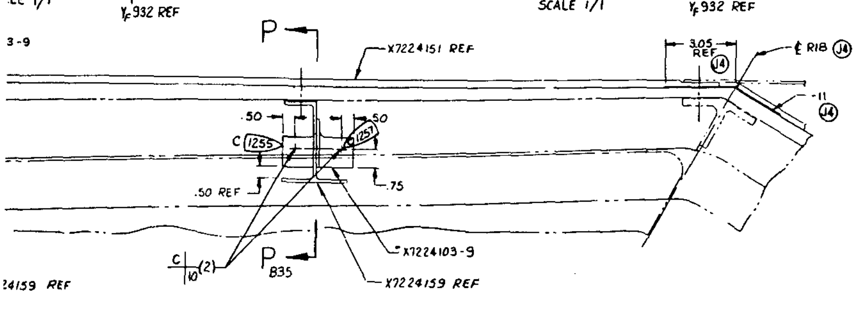
SECTION AA-AA C6
SCALE 1/2
ROTATED 32° CW



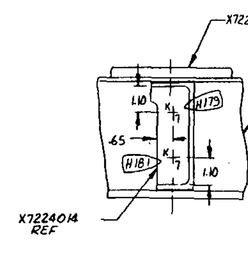
ON R-R A36
LE 1/1



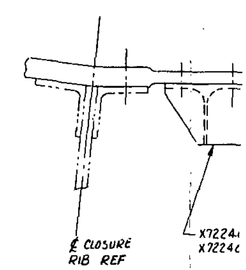
SECTION P-P A36
SCALE 1/1



SECTION N-N D22
SCALE 1/2



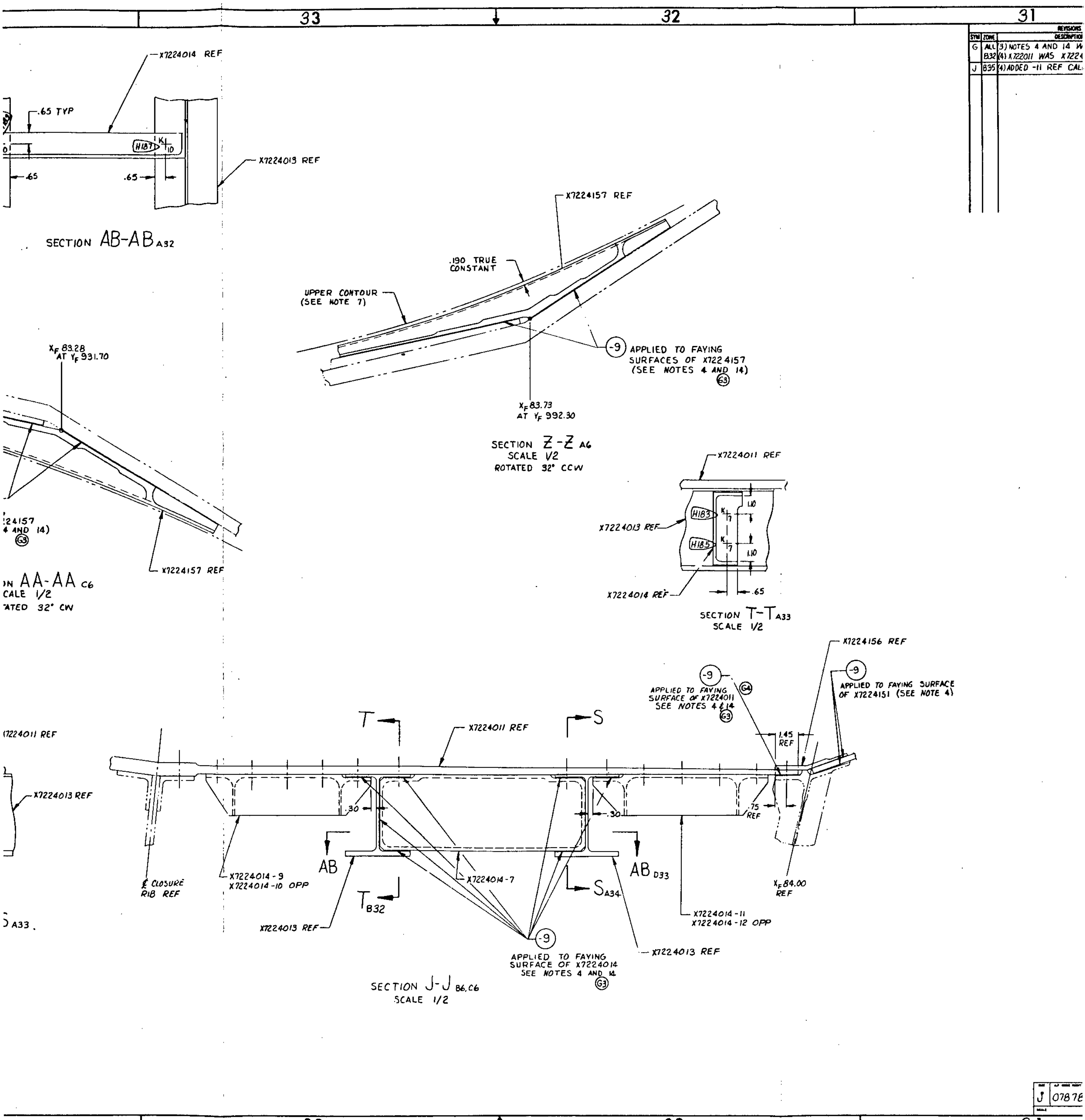
SECTION S-S A33.
SCALE 1/2



CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001	J	X7224010	3

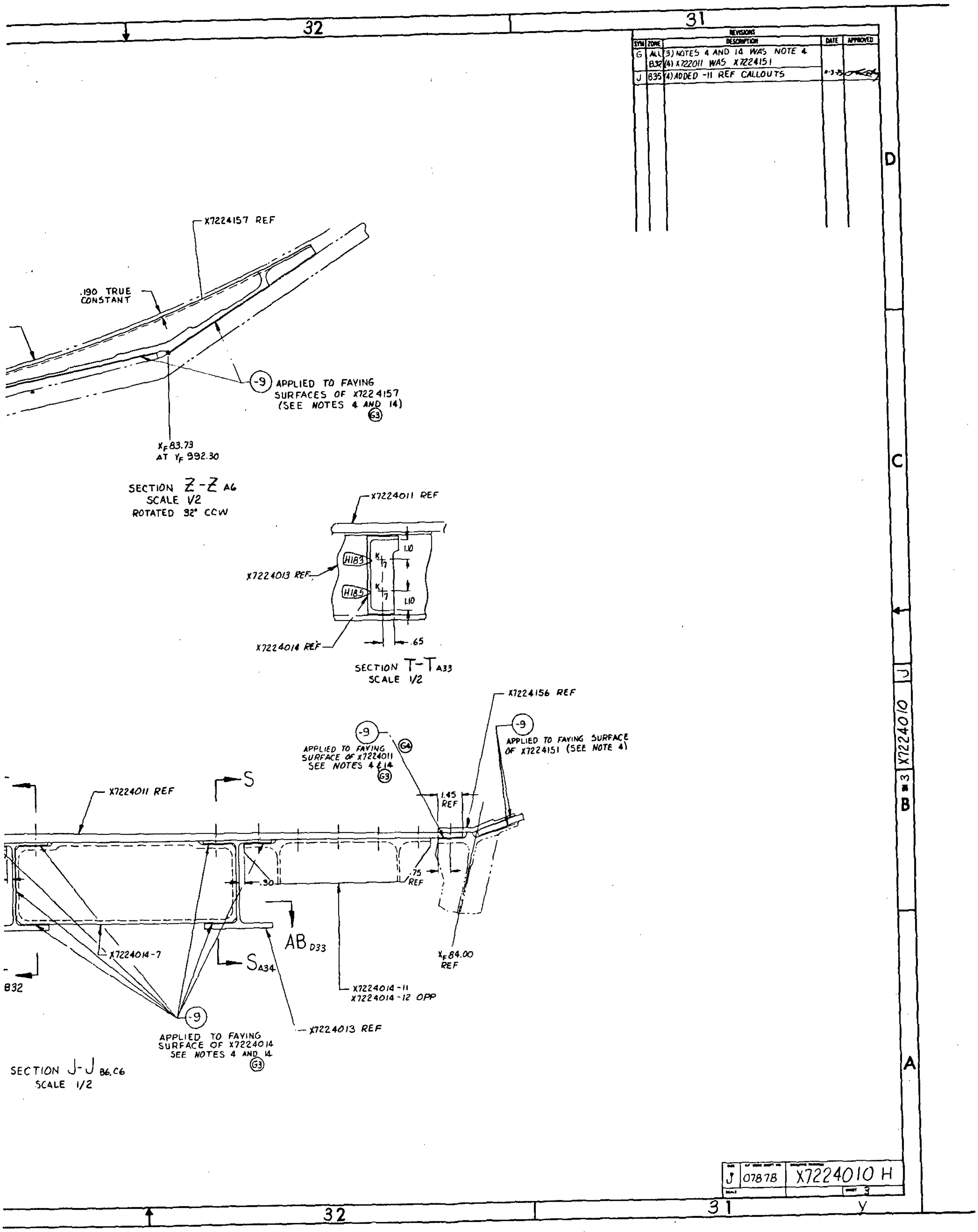
36	35	34	

2



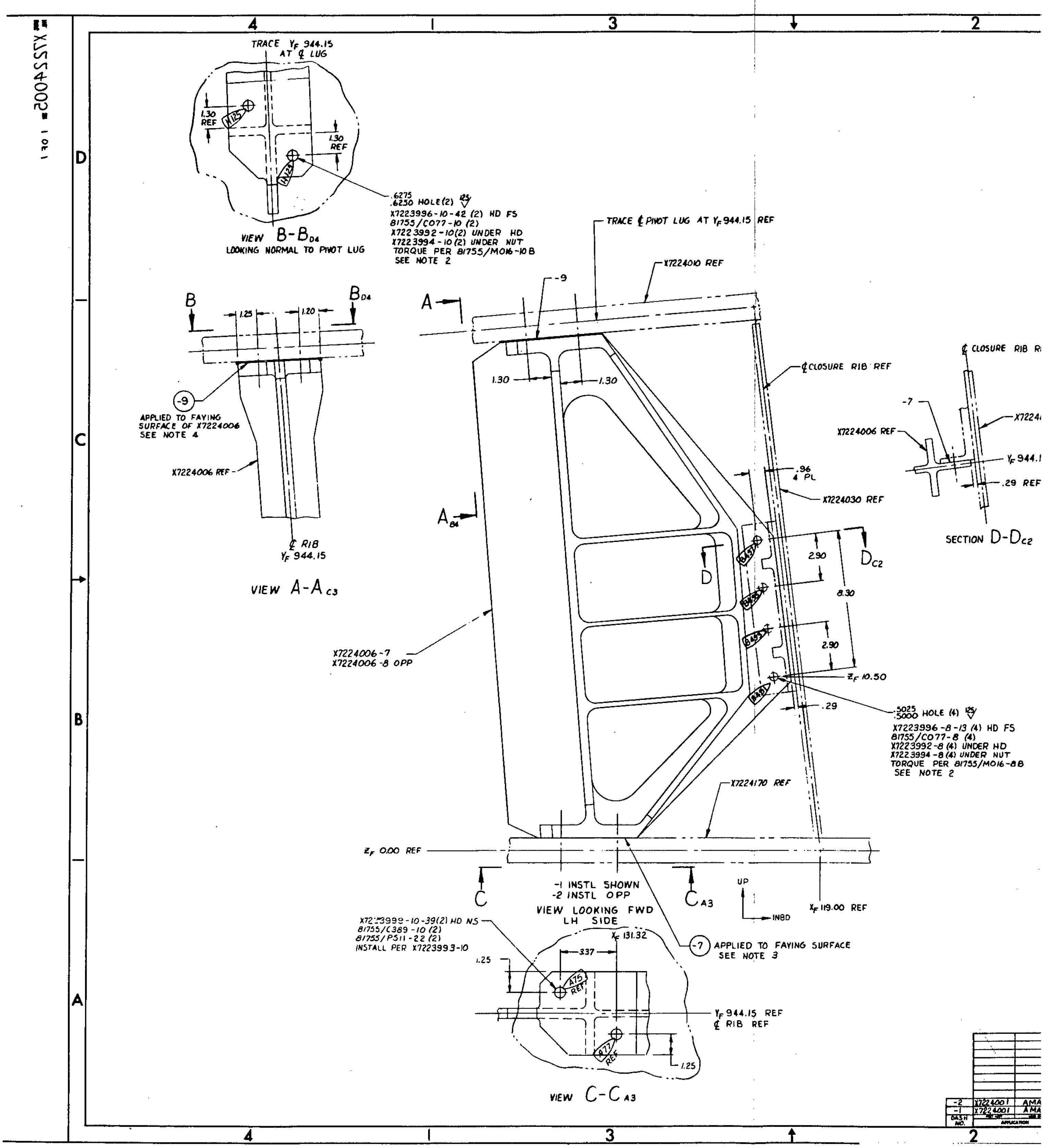
3

FIGURE 2.2.1-11, SHEET 3 OF 3
FASTENER HOLE IDENTIFICATION - UPPER



4

FIGURE 2.2.1-11, SHEET 3 OF 3
FASTENER HOLE IDENTIFICATION - UPPER COVER


TRACE Y_F 944.15 AT ℄ LUG
1.30 REF
1.30 REF
.6275 .6250 HOLE (2)
X7223996-10-42 (2) HD FS
81755/C077-10 (2)
X7223992-10 (2) UNDER HD
X7223994-10 (2) UNDER NUT
TORQUE PER 81755/M016-10 B
SEE NOTE 2
VIEW B-B D4
LOOKING NORMAL TO PIVOT LUG
TRACE ℄ PIVOT LUG AT Y_F 944.15 REF
X7224010 REF
1.25
1.20
APPLIED TO FAYING SURFACE OF X7224006 SEE NOTE 4
X7224006 REF
℄ RIB Y_F 944.15
VIEW A-A C3
1.30
1.30
℄ CLOSURE RIB REF
.96 4 PL
X7224030 REF
2.90
8.30
2.90
Z_F 10.50
.29
X7224006-7
X7224006-8 OPP
.5025 .5000 HOLE (4)
X7223996-8-13 (4) HD FS
81755/C077-8 (4)
X7223992-8 (4) UNDER HD
X7223994-8 (4) UNDER NUT
TORQUE PER 81755/M016-8B
SEE NOTE 2
X7224170 REF
Z_F 0.00 REF
-1 INSTL SHOWN
-2 INSTL OPP
VIEW LOOKING FWD
LH SIDE
UP
INBD
X_F 119.00 REF
℄ CLOSURE RIB R
X7224006 REF
Y_F 944.1
.29 REF
SECTION D-D C2
X7223999-10-39 (2) HD NS
81755/C389-10 (2)
81755/P511-22 (2)
INSTALL PER X7223993-10
X_F 131.32
.337
1.25
Y_F 944.15 REF
℄ RIB REF
1.25
APPLIED TO FAYING SURFACE
SEE NOTE 3
VIEW C-C A3
-2 X7224001 AMA
-1 X7224001 AMA
DASH NO.
APPLICATION

FASTENER HO

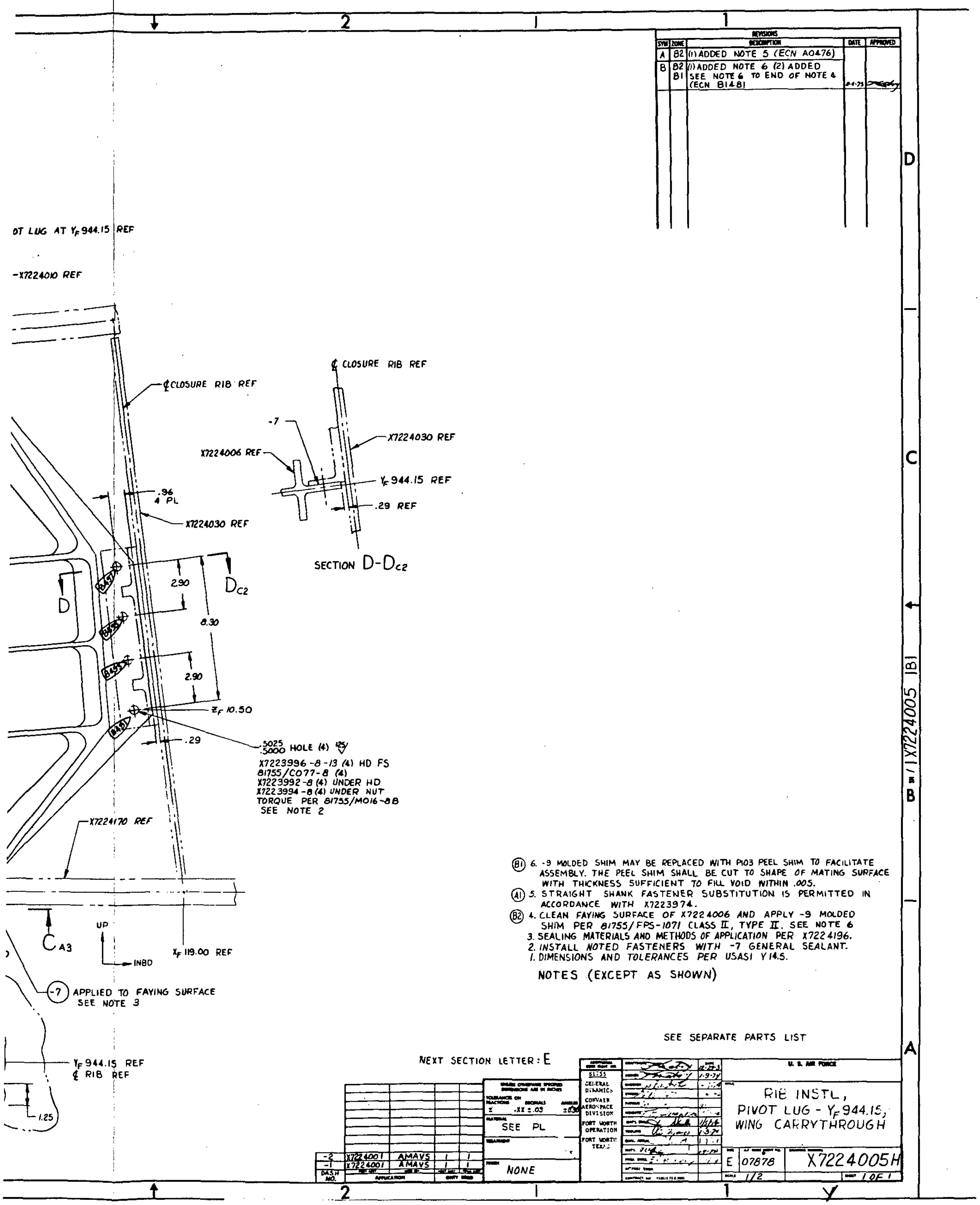
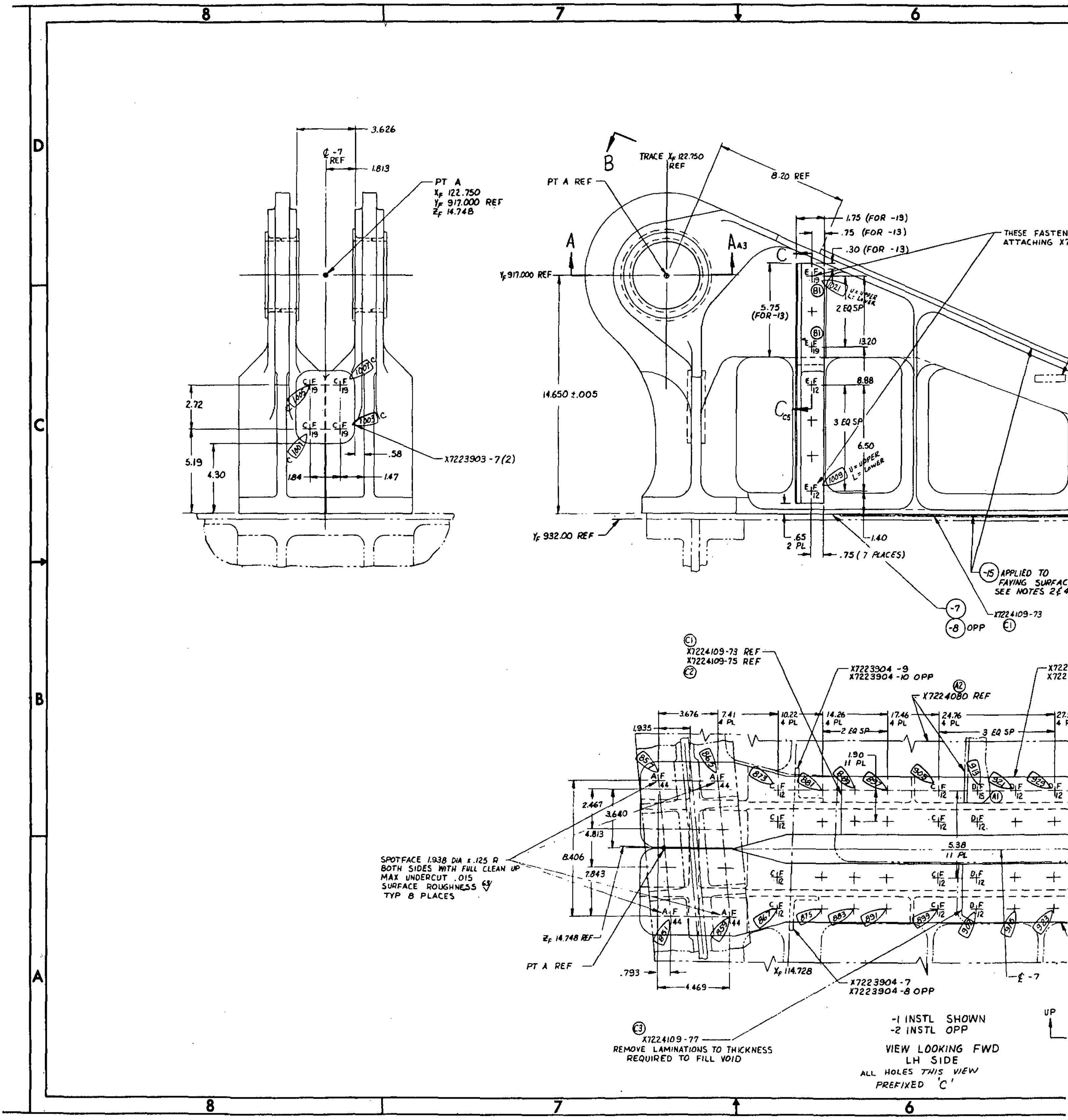
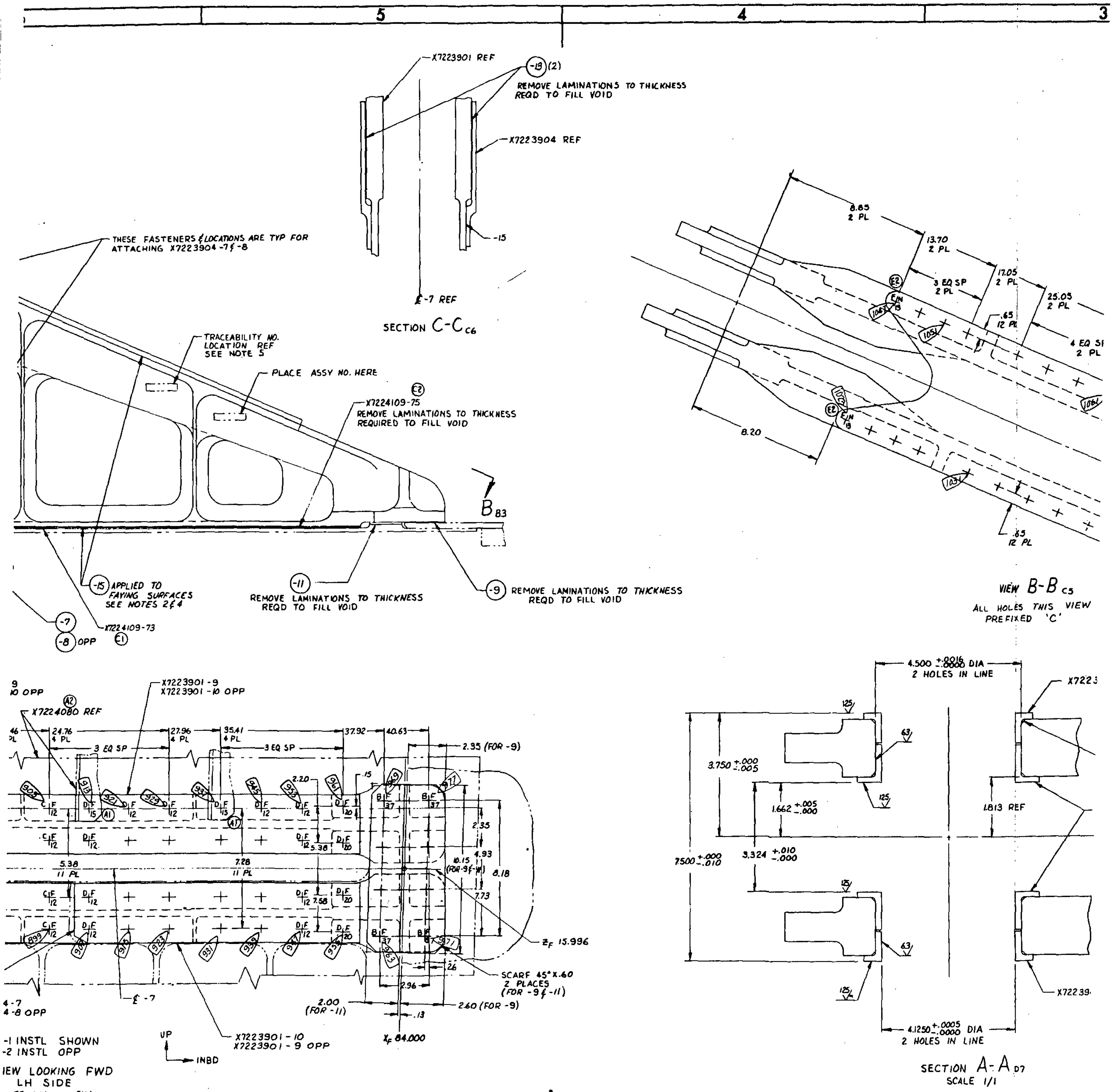


FIGURE 2.2.1-12
FASTENER HOLE IDENTIFICATION - PIVOT LUG RIB

2


8
7
6
D
C
B
A
3.626
℄ -7 REF
1.813
PT A
X_F 122.750
Y_F 917.000 REF
Z_F 14.748
2.72
5.19
4.30
1.84
1.47
.58
X7223903-7(2)
TRACE X_F 122.750 REF
PT A REF
8.20 REF
1.75 (FOR -19)
.75 (FOR -13)
.30 (FOR -13)
THESE FASTENE
ATTACHING X72
Y_F 917.000 REF
5.75 (FOR -13)
2 EQ SP
13.20
14.650 ±.005
8.88
3 EQ SP
6.50
U = UPPER
L = LOWER
Y_F 932.00 REF
.65
2 PL
1.40
.75 (7 PLACES)
-15 APPLIED TO FAYING SURFACE SEE NOTES 2 & 4
-7
-8 OPP
X7224109-73
X7224109-73 REF
X7224109-75 REF
X7223904 -9
X7223904 -10 OPP
X7224080 REF
3.676
7.41 4 PL
10.22 4 PL
14.26 4 PL
17.46 4 PL
24.76 4 PL
2 EQ SP
3 EQ SP
1.935
1.90 11 PL
2.467
3.640
4.813
8.406
7.843
5.38 11 PL
SPOTFACE 1.938 DIA x .125 R
BOTH SIDES WITH FULL CLEAN UP
MAX UNDERCUT .015
SURFACE ROUGHNESS 63
TYP 8 PLACES
Z_F 14.748 REF
PT A REF
.793
4.469
X_F 114.728
X7223904-7
X7223904-8 OPP
℄ -7
X7224109-77
REMOVE LAMINATIONS TO THICKNESS
REQUIRED TO FILL VOID
-1 INSTL SHOWN
-2 INSTL OPP
VIEW LOOKING FWD
LH SIDE
ALL HOLES THIS VIEW
PREFIXED 'C'
UP

1

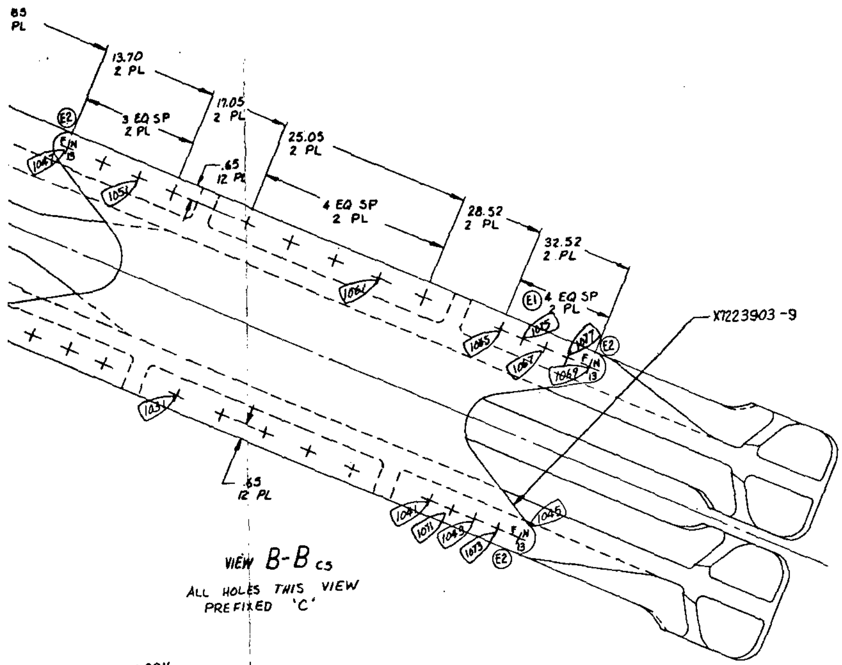


CONTRACT NO. F33615-73-C-3001 | REV E | DWG NO. X7223950 | SH 1

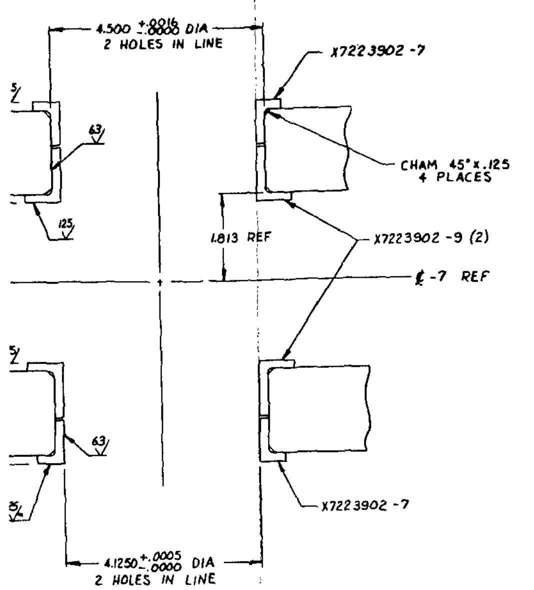
SEE FRAME 1 | SEE FRAME 2

2

SYM	ZONE	DESCRIPTION
A	B5 B6	(1) 15 GRIP WAS 12 (2) REVISED X7224080 PICTURE AND ADDED CALLOUT (ECN A1128)
B	C6	(1) 19 GRIP WAS 21 (ECN A0427)
C	B6 C5 A7	(1) ADDED X7224109-73 (2) ADDED X7224109-75 (3) ADDED X7224109-77 (ECN B0959)
D		(1) ADDED NOTE 9 (ECN A0472)
E	C3 C4	(1) 4 EQ SP WAS 2 EQ SP (2) F CODE WAS E (3) ADDED F CODE TO NOTE 6 (ECN A1590)



VIEW B-B C5
ALL HOLES THIS VIEW PREFIXED 'C'



SECTION A-A D7
SCALE 1/1

(D1) 9. STRAIGHT SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDA
WITH X7223974.
8. MARK ASSY PER X7224198 CLASS 2A.
7. SURFACE ROUGHNESS OF NOTED HOLES SHALL NOT EXCEED 63 IN S
AND TITANIUM AND 125 IN ALUMINUM.

6. FASTENER CODE:

BASIC CODE — HEAD LOCATION (N) NEAR SIDE (F) FAR SIDE — GRIP LENGTH DASH NO.

BASIC CODE	HOLE DIA	FASTENER	NUT 81755/	WASHER UNDER HD	WASHER UNDER NUT	TORQUE PER 81755/M016	H R
A	.8775 .8750	X7223995-14	C306-14	X7223988-14	X7223987-14	-14 D	
B	.5650 .5625	X7223995-9	C306-9	X7223988-9	X7223987-9	-9 D	SE
C	.5025 .5000	X7223996-8	C077-8	X7223992-8	X7223994-8	-8 B	
D	.3770 .3750	X7223996-6	C077-6	X7223992-6	X7223994-6	-6 B	
E	.3770 .3750	81755/C0042-12	C2950-12	X7223991-12	AN960PD616L	-6 A	
(E3) F	.3770 .3750	81755/C3002-12	C2950-12	X7223991-12	AN960PD616L	-6 A	

5. -7 & -8 CONTAIN FRACTURE CRITICAL DETAIL PARTS. RETAIN ORIGIN
MATERIAL TRACEABILITY NUMBERS IN ACCORDANCE WITH X7224199.
4. SEALING MATERIALS AND METHODS OF APPLICATION PER X7224
3. INSTALL ALL FASTENERS WITH -15 GENERAL SEALANT.
2. APPLY -15 GENERAL SEALANT TO ALL FAYING SURFACES.
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5.
NOTES (EXCEPT AS SHOWN)

SEE SEPARATE PARTS LI

NEXT SECTION LETTER: D

GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION FORT WORTH TEXAS

U. S. AIR FORCE

SUPPORT IN
WING SWE
ACTUAT

SEE PL

NONE

-2	X7224001	AMAVS
-1	X7224001	AMAVS

J 07878 X7

1/2

3

FIGURE 2.2.1-13
FASTENER HOLE IDENTIFICATION - WING SWEEP AC

2 | 1

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED
A	B5 B6	(1) 15 GRIP WAS 12 (2) REVISED X7224080 PICTURE AND ADDED CALLOUT (ECN A1128)		
B	C6	(1) 19 GRIP WAS 21 (ECN A0427)		
C	B6 C5 A7	(1) ADDED X7224109-73 (2) ADDED X7224109-75 (3) ADDED X7224109-77 (ECN B0959)		
D		(1) ADDED NOTE 9 (ECN A0472)		
E	C3 C4	(1) 4 EQ SP WAS 2 EQ SP (2) F CODE WAS E (3) ADDED F CODE TO NOTE 6 (ECN A1590)		

D

-9

C

(D1) 9. STRAIGHT-SHANK FASTENER SUBSTITUTION IS PERMITTED IN ACCORDANCE WITH X7223974.
8. MARK ASSY PER X7224198 CLASS 2A.
7. SURFACE ROUGHNESS OF NOTED HOLES SHALL NOT EXCEED 63 IN STEEL AND TITANIUM AND 125 IN ALUMINUM.

6. FASTENER CODE:

BASIC CODE
HEAD LOCATION
(N) NEAR SIDE
(F) FAR SIDE
GRIP LENGTH DASH NO.

BASIC CODE	HOLE DIA	FASTENER	NUT 81755/	WASHER UNDER HD	WASHER UNDER NUT	TORQUE PER 81755/M016	HOLE SURF ROUGHNESS
A	.8775 .8750	X7223995-14	C306-14	X7223988-14	X7223987-14	-14 D	63
B	.5650 .5625	X7223995-9	C306-9	X7223988-9	X7223987-9	-9 D	SEE NOTE 7
C	.5025 .5000	X7223996-8	C077-8	X7223992-8	X7223994-8	-8 B	125
D	.3770 .3750	X7223996-6	C077-6	X7223992-6	X7223994-6	-6 B	125
E	.3770 .3750	81755/C0202-12	C2950-12	X7223991-12	AN960PD616L	-6 A	125
(E3) F	.3770 .3750	81755/C3002-12	C2950-12	X7223991-12	AN960PD616L	-6 A	125

5. -7 & -8 CONTAIN FRACTURE CRITICAL DETAIL PARTS. RETAIN ORIGINAL MATERIAL TRACEABILITY NUMBERS IN ACCORDANCE WITH X7224199.
4. SEALING MATERIALS AND METHODS OF APPLICATION PER X7224196.
3. INSTALL ALL FASTENERS WITH -15 GENERAL SEALANT.
2. APPLY -15 GENERAL SEALANT TO ALL FAYING SURFACES.
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5.

NOTES (EXCEPT AS SHOWN)

SEE SEPARATE PARTS LIST

NEXT SECTION LETTER: D

-2	X7224001 AMAVS
-1	X7224001 AMAVS
BASIC NO.	APPLICATION

MATERIAL: SEE PL

FINISH: NONE

GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION FORT WORTH, TEXAS

U. S. AIR FORCE

SUPPORT INSTL - WING SWEEP ACTUATOR

J | 07878 | X7223950 H

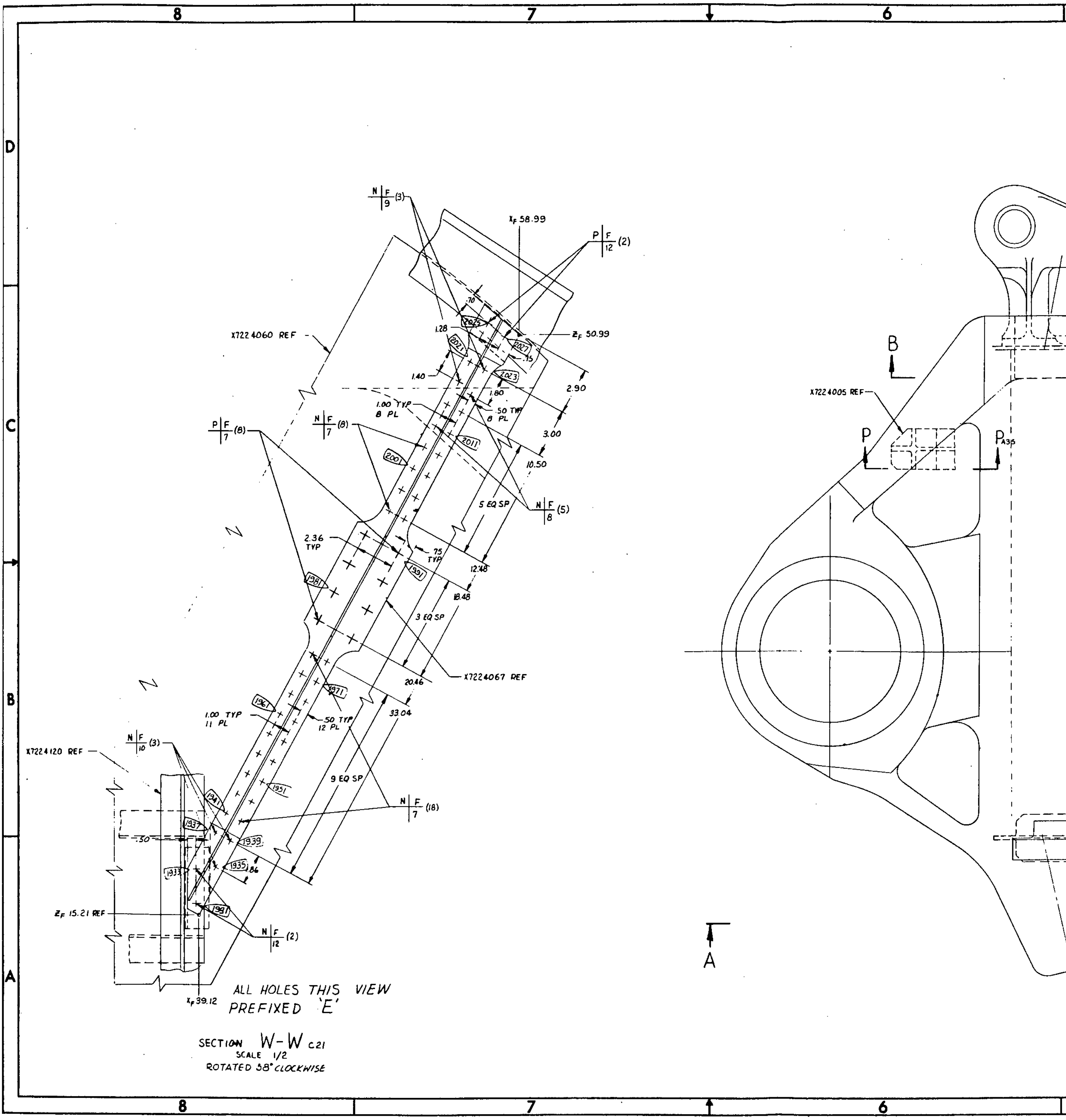
SCALE 1/2 | SHEET 1 OF 1

X7223950 E | B

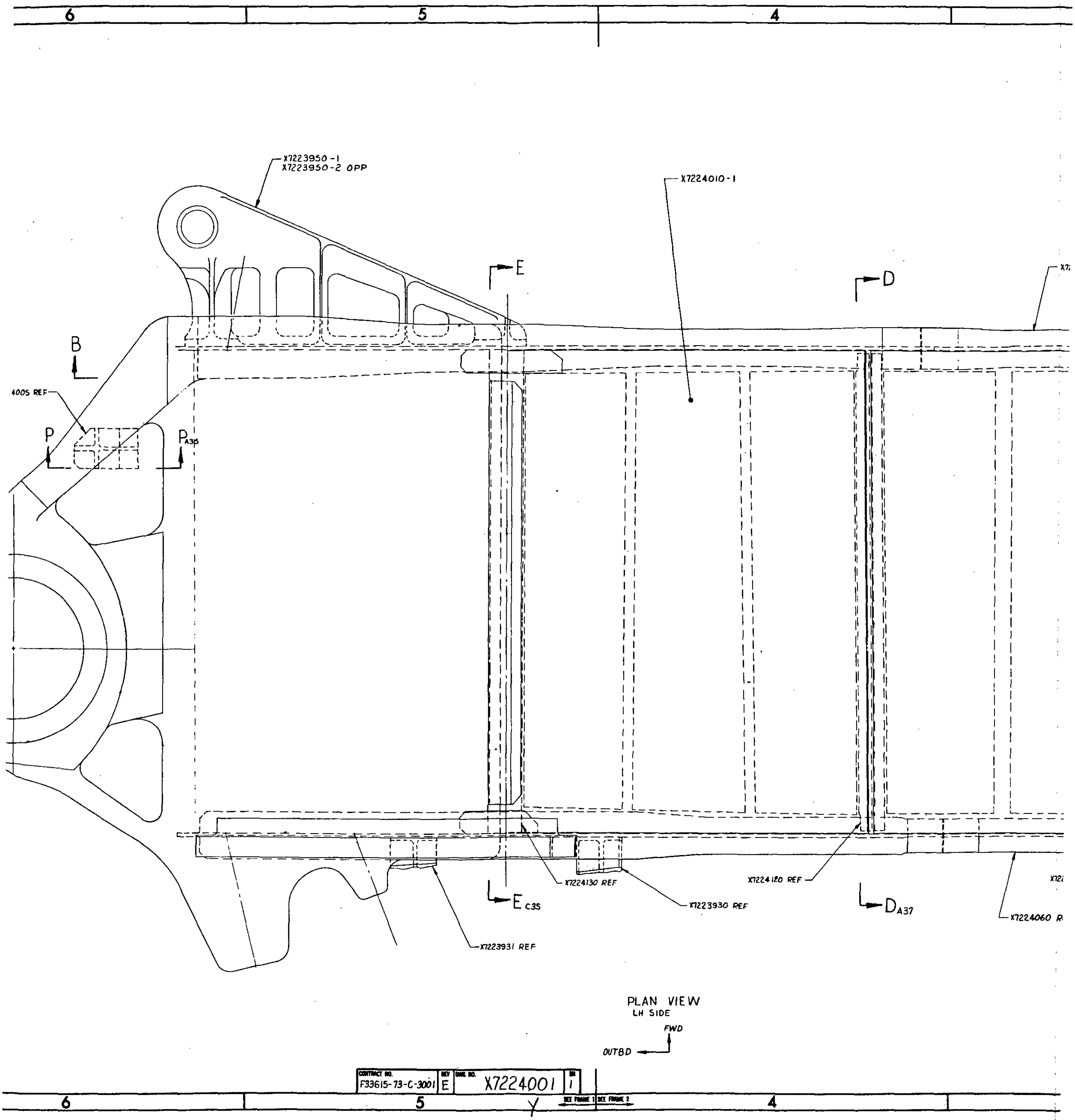
A

FIGURE 2.2.1-13
ASTENER HOLE IDENTIFICATION - WING SWEEP ACTUATOR

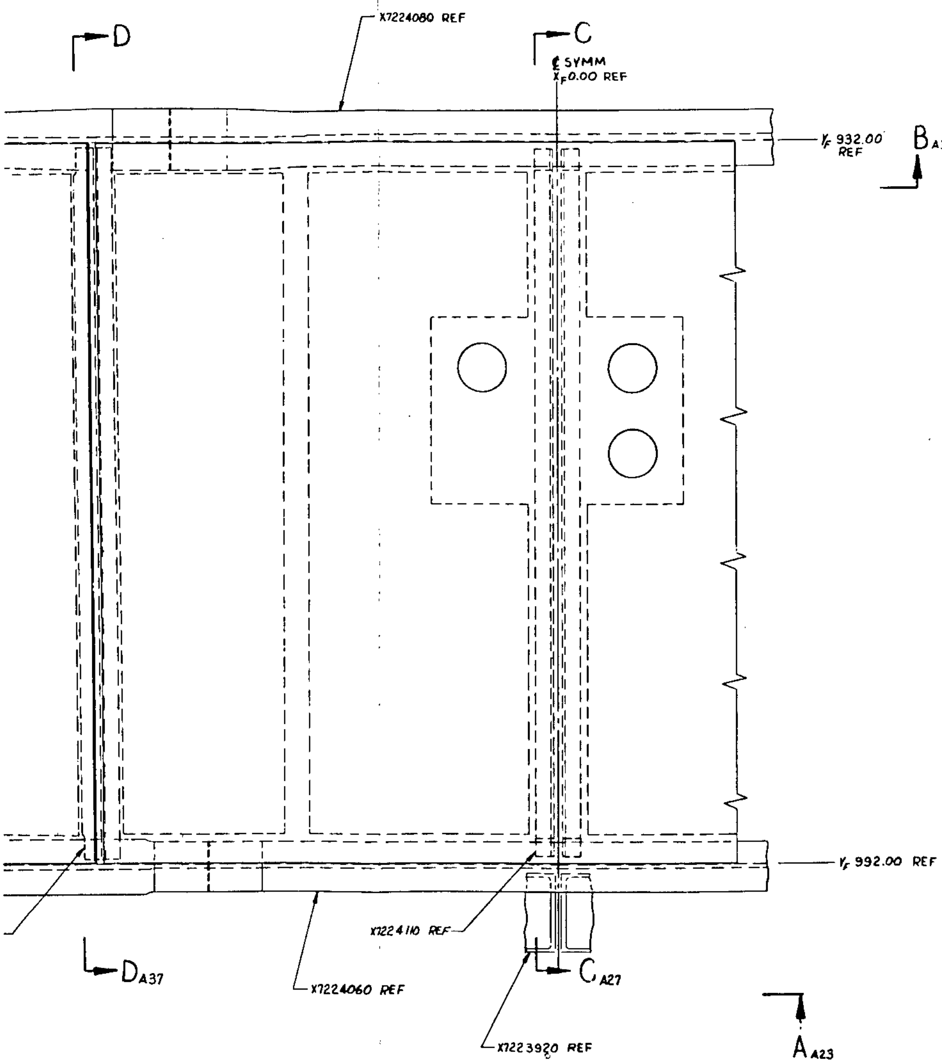
4



8
7
6
D
C
B
A
X7224060 REF
X7224005 REF
X7224067 REF
X7224120 REF
X_F 58.99
Z_F 50.99
Z_F 15.21 REF
X_F 39.12
5 EQ SP
3 EQ SP
9 EQ SP
1.00 TYP 8 PL
.50 TYP 8 PL
1.00 TYP 11 PL
.50 TYP 12 PL
2.36 TYP
.75 TYP
2.90
3.00
10.50
12.48
18.48
20.46
33.04
B
P
A
ALL HOLES THIS VIEW PREFIXED 'E'
SECTION W-W C21
SCALE 1/2
ROTATED 58° CLOCKWISE


6
5
4
X7223950-1
X7223950-2 OPP
X7224010-1
E
D
B
4005 REF
P
P A35
E C35
D A37
X7224130 REF
X7223930 REF
X7224120 REF
X7224060 R
X7223931 REF
PLAN VIEW
LH SIDE
FWD
OUTBD
CONTRACT NO. F33615-73-C-3001
REV E
DWG NO. X7224001
SH 1
SEE FRAME 1
SEE FRAME 2
Y

SYM	ZONE	REVISIONS DESCRIPTION
A		REVISED SHT 2
B		REVISED SHT 5 (
C		REVISED SHT 6 (
D	B2	(1) ADDED SEE NOTE 4 (ECN
E		REVISED SHT 5



(NOTES CONTINUED ZONE A21)

9. FASTENER CODE:

BASIC CODE — HEAD LOCATION (N) NEAR SIDE (F) FAR SIDE NO CODE = LOCATION OPTIONAL — GRIP LENGTH DASH NO.

BASIC CODE	HOLE DIA	FASTENER	NUT 81755/	WASHER UNDER HEAD	WASHER UNDER NUT	TORQ
A	SEE SPEC	X7223999-6-	C389-6	81755/P511-10	X7223986-6	INS
B	SEE SPEC	X7223999-7-	C389-7	81755/P511-13	X7223986-7	INS
C	SEE SPEC	X7223999-8-	C389-8	81755/P511-16	X7223986-8	INS
D	SEE SPEC	X7223999-10-	C389-10	81755/P511-22	X7223986-10	INS
E	SEE SPEC	X7223999-12-	C389-12	81755/P511-24	X7223986-12	INS
F	SEE SPEC	X7223999-14-	C389-14	81755/P511-27	X7223986-14	INS
G	.3770 .3746	X7223996-6-	C077-6	X7223992-6	X7223994-6	8175
H	.4395 .4371	X7223996-7-	C077-7	X7223992-7	X7223994-7	8175
J	.5025 .4996	X7223996-8-	C077-8	X7223992-8	X7223994-8	8175
K	.6275 .6241	X7223996-10-	C077-10	X7223992-10	X7223994-10	8175
L	.5025 .4996	81755/C4550-8-	C077-8	X7223992-8	X7223994-8	8175
M	.6275 .6241	81755/C4550-10-	C077-10	X7223992-10	X7223994-10	8175
N	.2520 .2496	81755/C020-8-	C2950-8	X7223991-8	NONE	8175
P	.3770 .3746	81755/C020-12-	C2950-12	X7223991-12	NONE	8175
R	.5650 .5617	X7223996-9-	C077-9	X7223992-9	X7223994-9	8175
S	.3145 .3121	81755/C020-10-	C2950-10	X7223991-10	NONE	8175

8. -1 CONTAINS FRACTURE CRITICAL DETAILS. RETAIN ORIGINAL TRACEABILITY NUMBERS IN ACCORDANCE WITH X7224199
7. MARK ASSY NO. PER X7224198 CLASS 2 A.
6. PROTECTIVE FINISH NOTED SPOTFACES AS FOLLOWS:
   A. CLEAN AND APPLY CHEMICAL FILM PER MIL-C-5
   B. APPLY TWO COATS MIL-P-23377 EPOXY-POLYAMIDE
5. SURFACE ROUGHNESS OF ALL STRAIGHT SHANK FASTENE NOT EXCEED 125.
(D1) 4. CLEAN NOTED FAYING SURFACES AND APPLY -9 MOL 81755/FPS-1071 CLASS II, TYPE II. SEE NOTE 11
3. SEALING MATERIALS AND METHODS OF APPLICATION P
2. APPLY -7 GENERAL SEALANT TO ALL FAYING SURFACES STRAIGHT SHANK FASTENERS.
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5.

NOTES (EXCEPT AS SHOWN)

REV STATUS	
SH	REV
1	E
2	D
3	—
4	—
5	E
6	C

SEE SEPARATE

NEXT SECTION LETTER: AM

81755 GENERAL DYNAMICS CONVAIR AEROSPACE DIVISION FORT WORTH OPERATION FORT WORTH TEXAS

MATERIAL SEE PL

FINISH SEE NOTE 6

-1 DASH NO. | END ITEM | AMAYS

J 0787

1/4

3

FIGURE 2.2.1-14, SHEET 1 OF
FASTENER HOLE IDENTIFICATION - WCT

2		1		

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED
A		REVISED SHT 2 (ECN A0475)		
B		REVISED SHT 5 (ECN B1427)		
C		REVISED SHT 6 (ECN A 1568)		
D	B2	(1) ADDED SEE NOTE 11 TO END OF NOTE 4 (ECN B1480)		
E		REVISED SHT 5 (ECN A1601)	8-4-75	

D

(NOTES CONTINUED ZONE A21)

9. FASTENER CODE:

BASIC CODE — HEAD LOCATION
(N) NEAR SIDE
(F) FAR SIDE
NO CODE = LOCATION OPTIONAL
— GRIP LENGTH DASH NO.

3 A33

BASIC CODE	HOLE DIA	FASTENER	NUT 81755/	WASHER UNDER HEAD	WASHER UNDER NUT	TORQUE PER	INSTL SPEC
A	SEE SPEC	X7223999-6-	C389-6	81755/P511-10	X7223986-6	INSTL SPEC	X7223993-6
B	SEE SPEC	X7223999-7-	C389-7	81755/P511-13	X7223986-7	INSTL SPEC	X7223993-7
C	SEE SPEC	X7223999-8-	C389-8	81755/P511-16	X7223986-8	INSTL SPEC	X7223993-8
D	SEE SPEC	X7223999-10-	C389-10	81755/P511-22	X7223986-10	INSTL SPEC	X7223993-10
E	SEE SPEC	X7223999-12-	C389-12	81755/P511-24	X7223986-12	INSTL SPEC	X7223993-12
F	SEE SPEC	X7223999-14-	C389-14	81755/P511-27	X7223986-14	INSTL SPEC	X7223993-14
G	.3770 .3746	X7223996-6-	C077-6	X7223992-6	X7223994-6	81755/M016-6 B	NONE
H	.4395 .4371	X7223996-7-	C077-7	X7223992-7	X7223994-7	81755/M016-7 B	NONE
J	.5025 .4996	X7223996-8-	C077-8	X7223992-8	X7223994-8	81755/M016-8 B	NONE
K	.6275 .6241	X7223996-10-	C077-10	X7223992-10	X7223994-10	81755/M016-10B	NONE
L	.5025 .4996	81755/C4550-8-	C077-8	X7223992-8	X7223994-8	81755/M016-8B	NONE
M	.6275 .6241	81755/C4550-10-	C077-10	X7223992-10	X7223994-10	81755/M016-10 B	NONE
N	.2520 .2496	81755/C020-8-	C2950-8	X7223991-8	NONE	81755/M016-4A	NONE
P	.3770 .3746	81755/C020-12-	C2950-12	X7223991-12	NONE	81755/M016-6 A	NONE
R	.5650 .5617	X7223996-9-	C077-9	X7223992-9	X7223994-9	81755/M016-9A	NONE
S	.3145 .3121	81755/C020-10-	C2950-10	X7223991-10	NONE	81755/M016-5B	NONE

C

8. -1 CONTAINS FRACTURE CRITICAL DETAILS. RETAIN ORIGINAL DETAIL MATL, TRACEABILITY NUMBERS IN ACCORDANCE WITH X7224199.
7. MARK ASSY NO. PER X7224198 CLASS 2 A.
6 PROTECTIVE FINISH NOTED SPOTFACES AS FOLLOWS:
   A. CLEAN AND APPLY CHEMICAL FILM PER MIL-C-5541
   B. APPLY TWO COATS MIL-P-23377 EPOXY-POLYAMIDE PRIMER PER MIL-F-18264.
5. SURFACE ROUGHNESS OF ALL STRAIGHT SHANK FASTENER HOLES SHALL NOT EXCEED 125.
D1 4. CLEAN NOTED FAYING SURFACES AND APPLY -9 MOLDED SHIM PER 81755/FPS-1071 CLASS II, TYPE II. SEE NOTE 11
3. SEALING MATERIALS AND METHODS OF APPLICATION PER X7224196.
2. APPLY -7 GENERAL SEALANT TO ALL FAYING SURFACES AND TO SHANK OF ALL STRAIGHT SHANK FASTENERS.
1. DIMENSIONS AND TOLERANCES PER USASI Y14.5.

NOTES (EXCEPT AS SHOWN)

EF

X7224001 E

B

REV STATUS	
SH	REV
1	E
2	D
3	—
4	—
5	E
6	C

SEE SEPARATE PARTS LIST

NEXT SECTION LETTER: AM

A

-1 DASH NO.	END ITEM	AMAVS
	APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± DECIMALS .XX ± .03 .XXX ± .010 ANGLES ± 1/30
MATERIAL SEE PL
FINISH SEE NOTE 6

81755
GENERAL DYNAMICS
CONVAIR AEROSPACE DIVISION
FORT WORTH OPERATION
FORT WORTH TEXAS

U. S. AIR FORCE

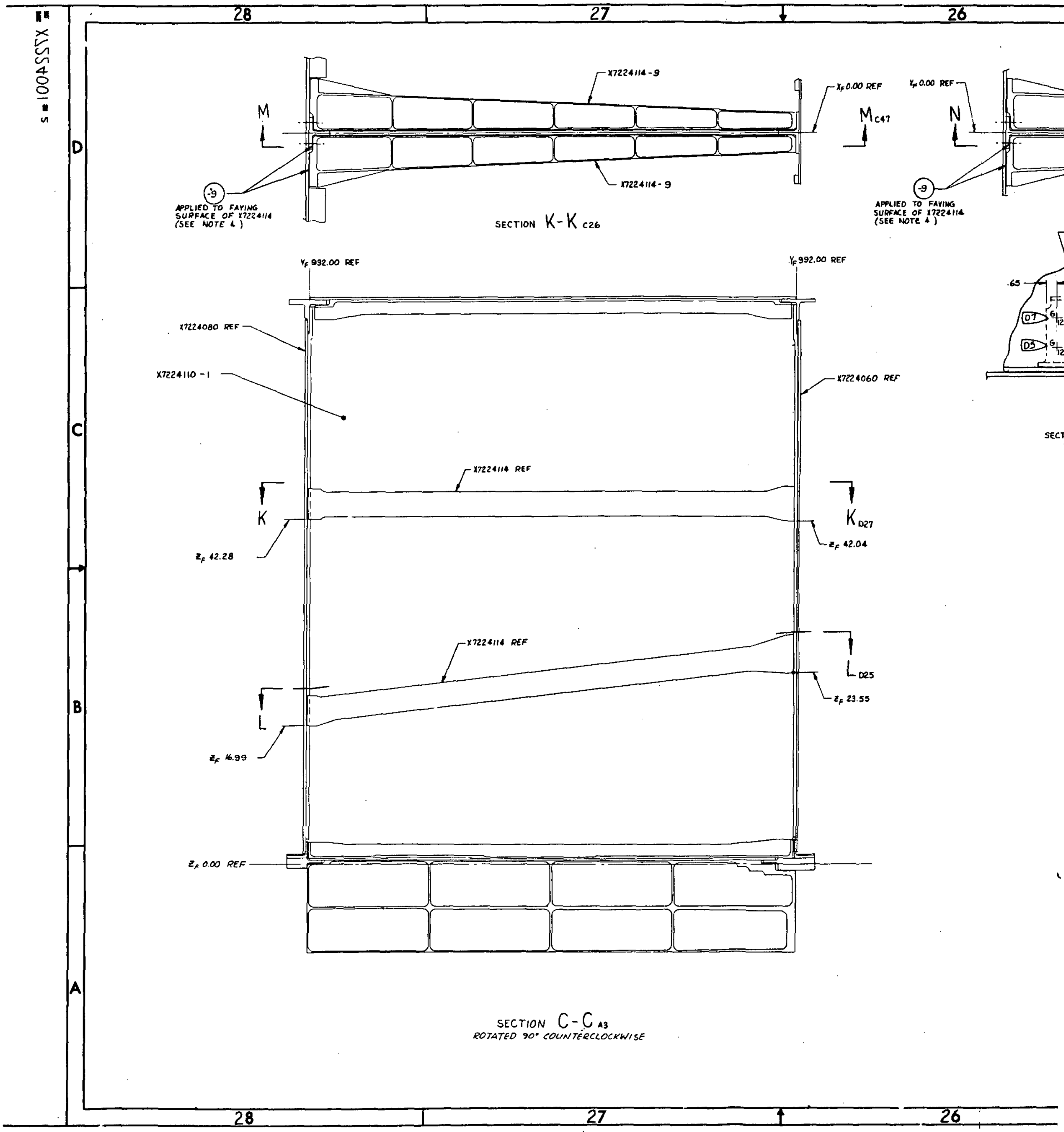
SUPPORT ASSY,
WING PIVOT -
Y_F 932 TO Y_F 992

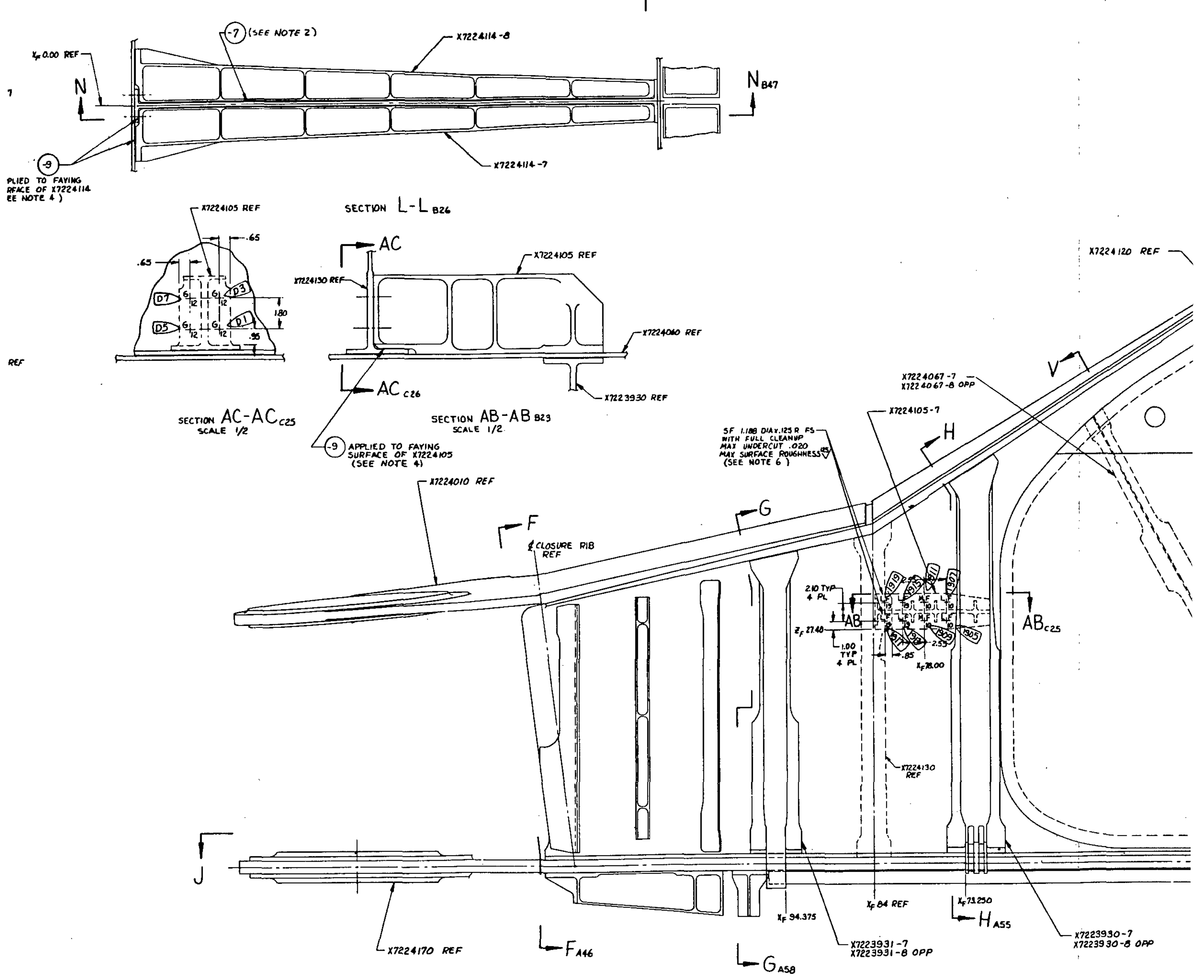
SIZE	CODE IDENT NO.	DRAWING NUMBER
J	07878	X7224001
SCALE 1/4		SHEET 1 OF 6

2		1	Y

FIGURE 2.2.1-14, SHEET 1 OF 6
FASTENER HOLE IDENTIFICATION - WCTS ASSEMBLY

4


28
27
26
D
C
B
A
X7224114-9
X_F 0.00 REF
M
M_{C47}
N
-9
APPLIED TO FAYING SURFACE OF X7224114 (SEE NOTE 4)
SECTION K-K C26
Y_F 992.00 REF
Y_F 992.00 REF
.65
D7
D5
X7224080 REF
X7224110-1
X7224060 REF
SECT
X7224114 REF
K
K_{D27}
Z_F 42.28
Z_F 42.04
X7224114 REF
L
L_{D25}
Z_F 23.55
Z_F 16.99
Z_F 0.00 REF
SECTION C-C A3
ROTATED 90° COUNTERCLOCKWISE

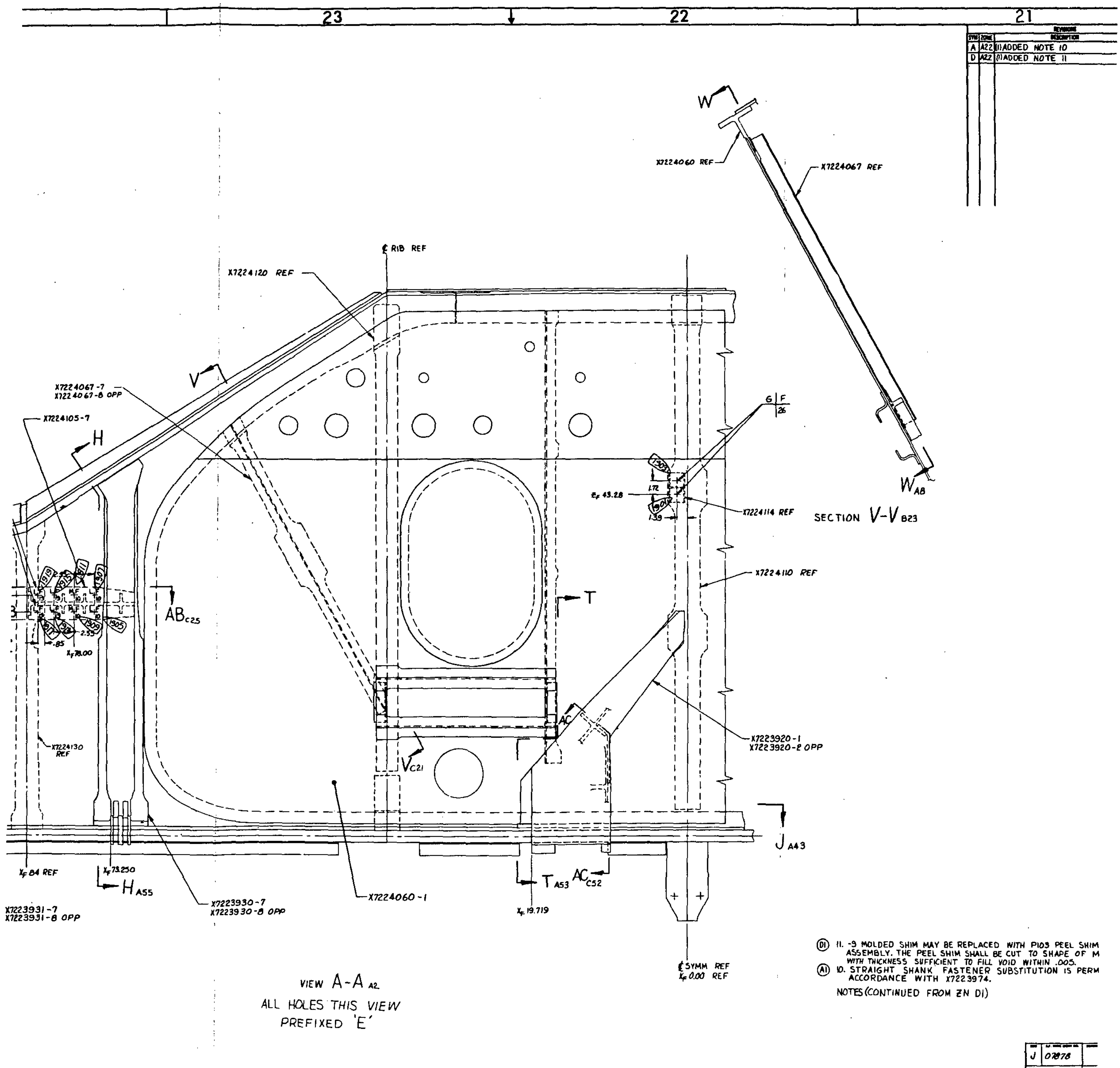


CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001	D	X7224001	2

26 | 25 | 24

SEE FRAME 1 | SEE FRAME 2

2



3

FIGURE 2.2.1-14, SHEET 2 OF 6
FASTENER HOLE IDENTIFICATION - WCTS A

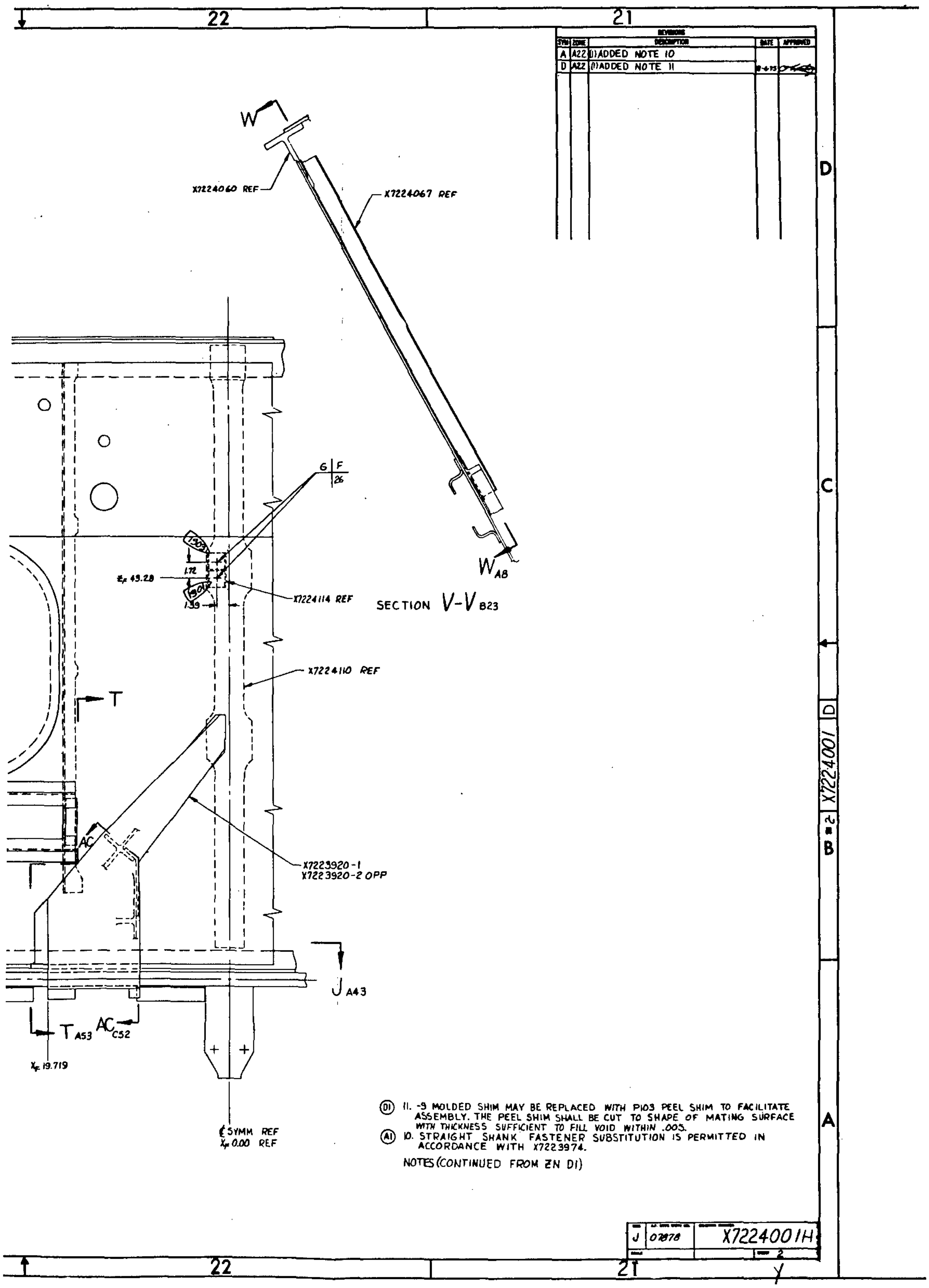
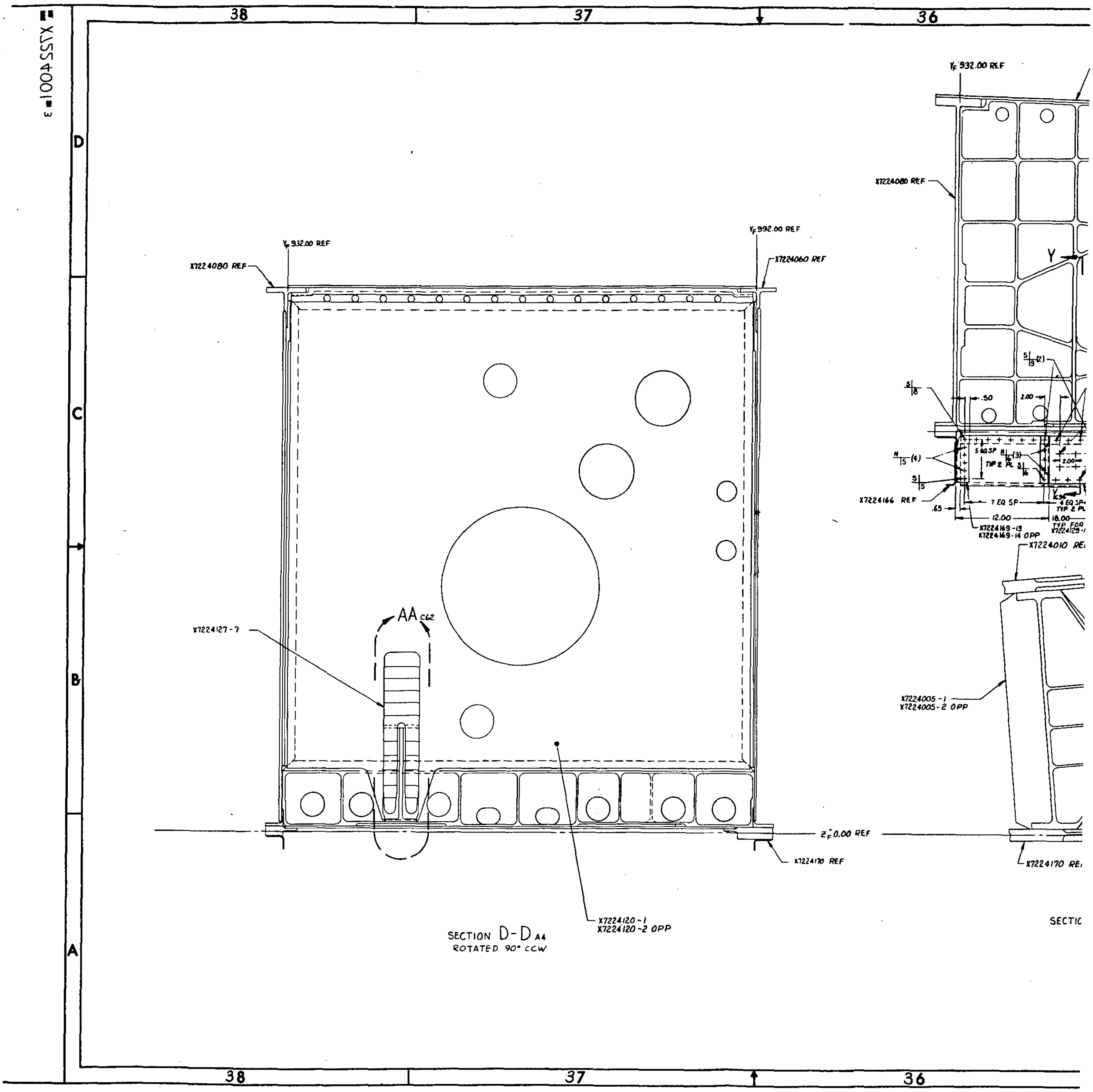
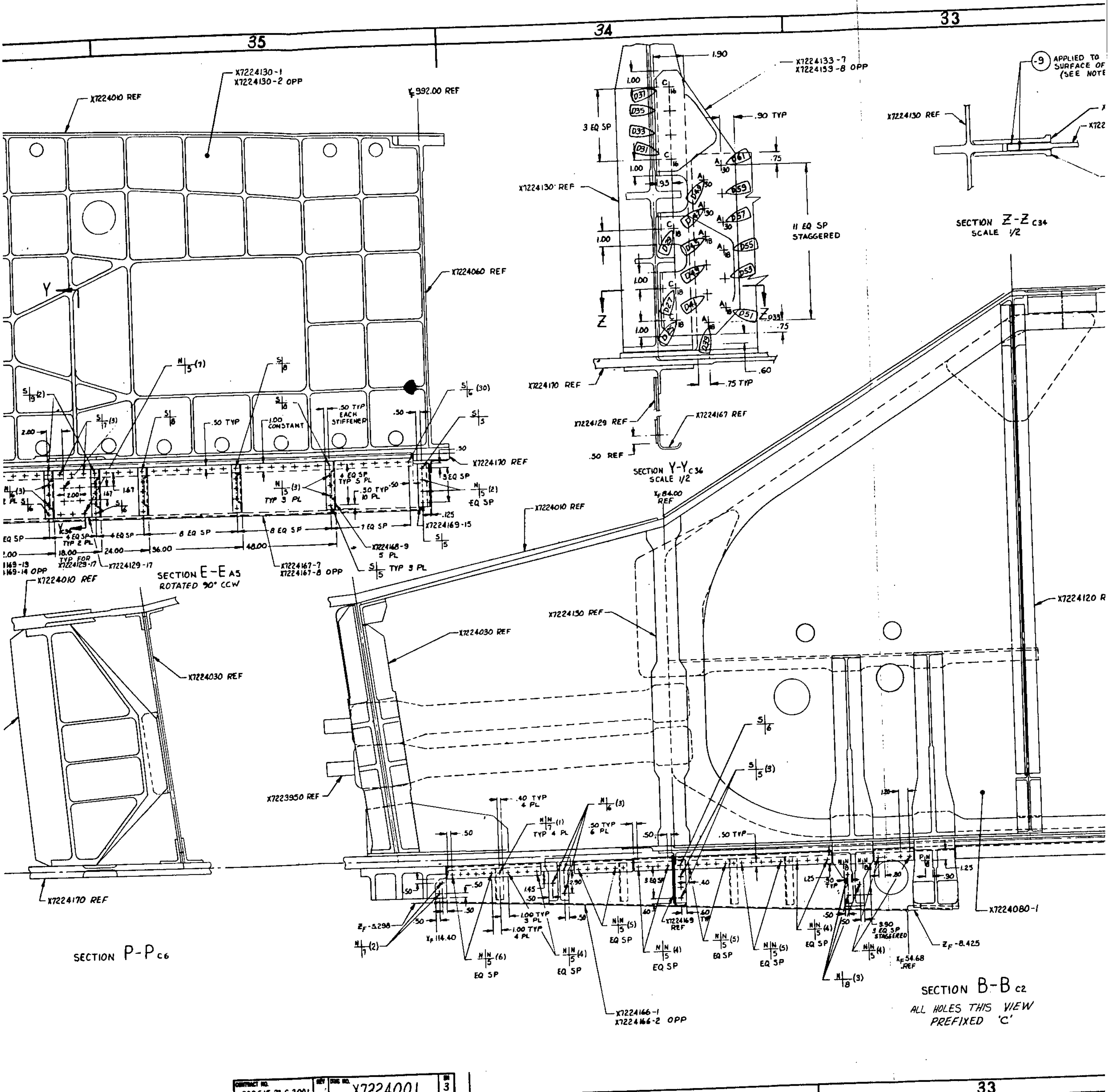


FIGURE 2.2.1-14, SHEET 2 OF 6
FASTENER HOLE IDENTIFICATION - WCTS ASSEMBLY

4

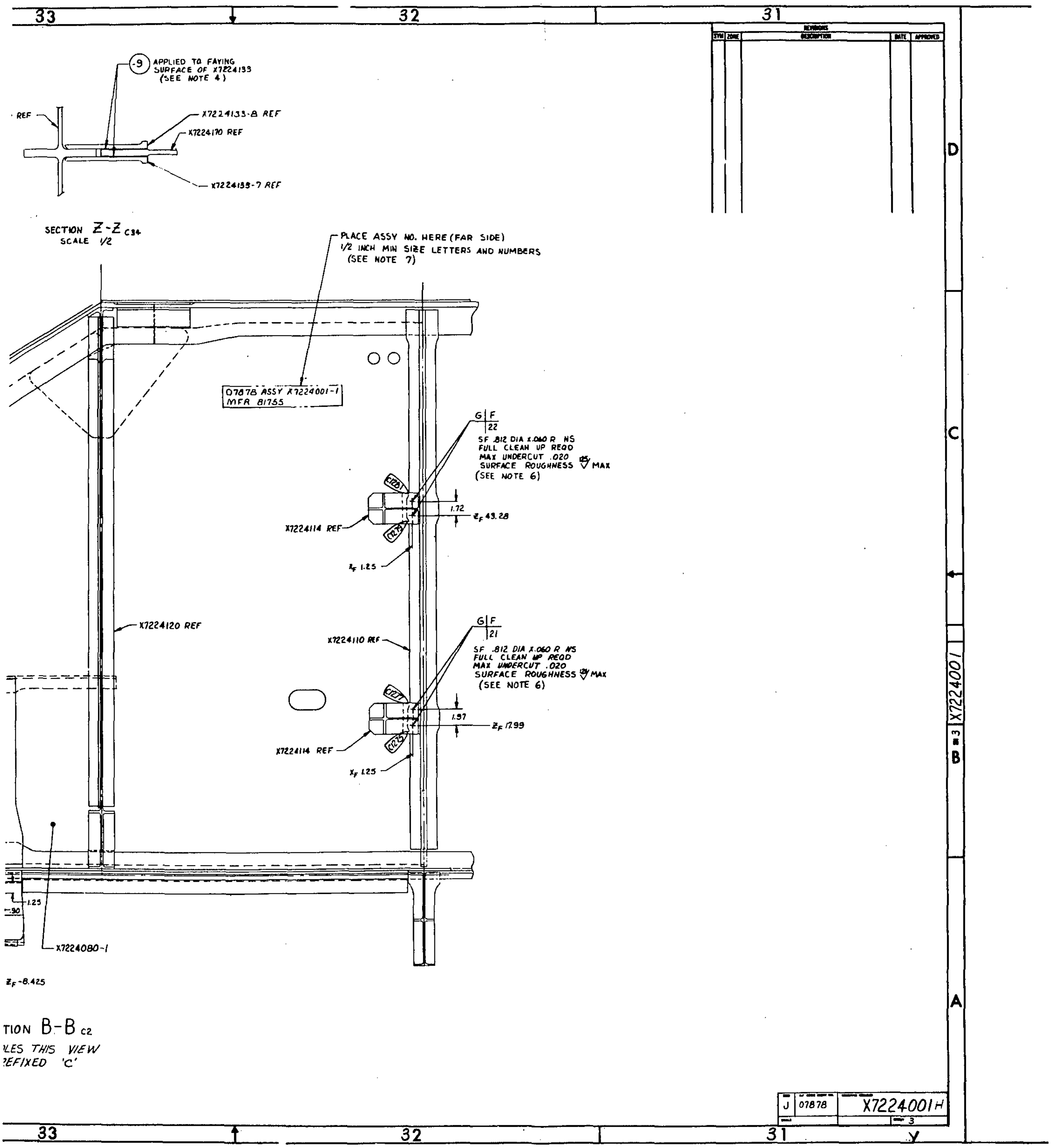

38
37
36
D
C
B
A
Y_F 932.00 REF
X7224080 REF
Y_F 992.00 REF
X7224060 REF
X7224127-7
AA C62
Z_F 0.00 REF
X7224170 REF
X7224120-1
X7224120-2 OPP
SECTION D-D A4
ROTATED 90° CCW
X7224080 REF
.50
2.00
X7224166 REF
7 EQ SP
12.00
18.00
.65
X7224169-13
X7224169-14 OPP
X7224010 RE
X7224005-1
X7224005-2 OPP
X7224170 RE
SECTIC



CONTRACT NO.	DWG NO.	SH
F33615-73-C-3001	X7224001	3

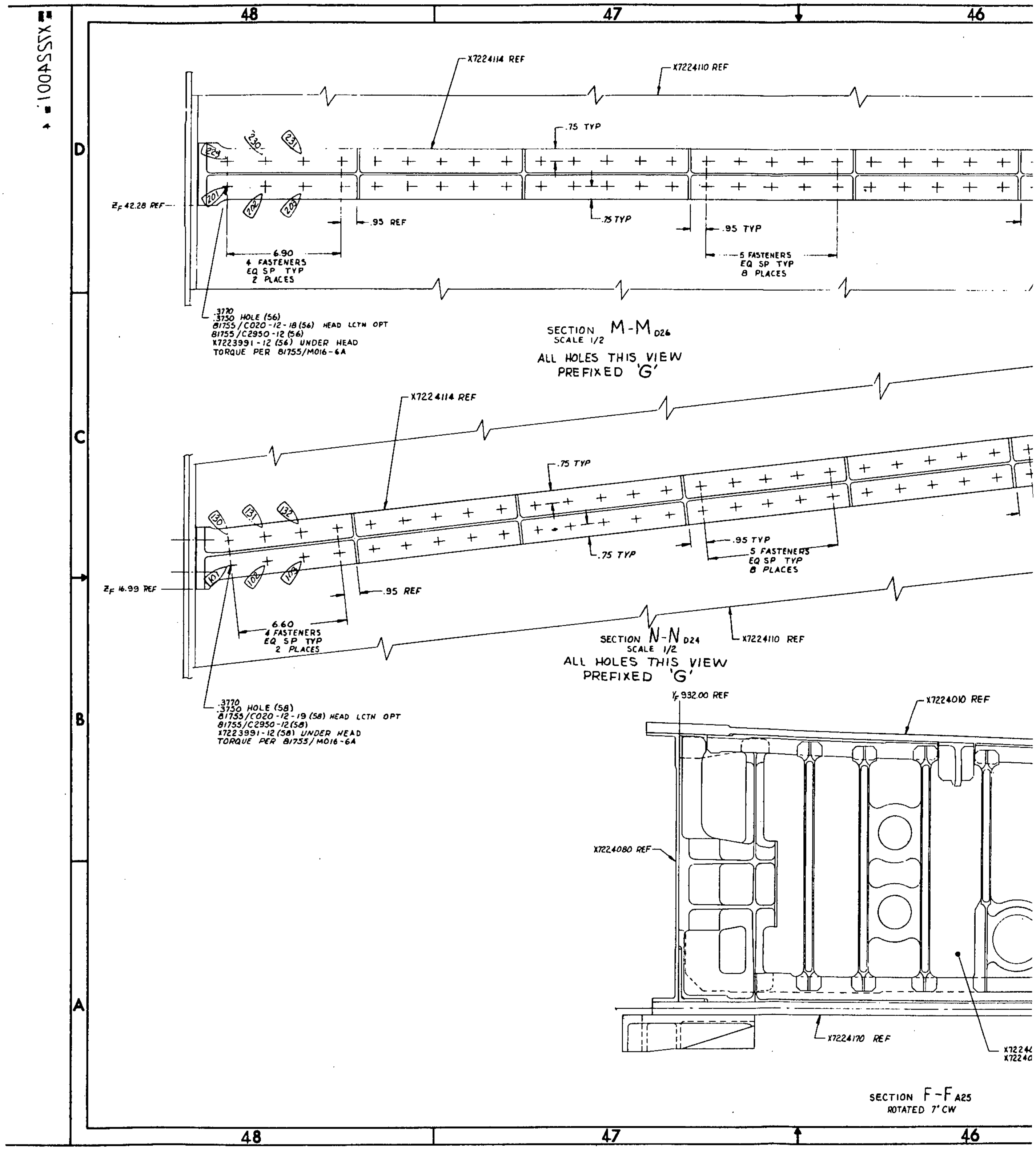
35 34 33

2

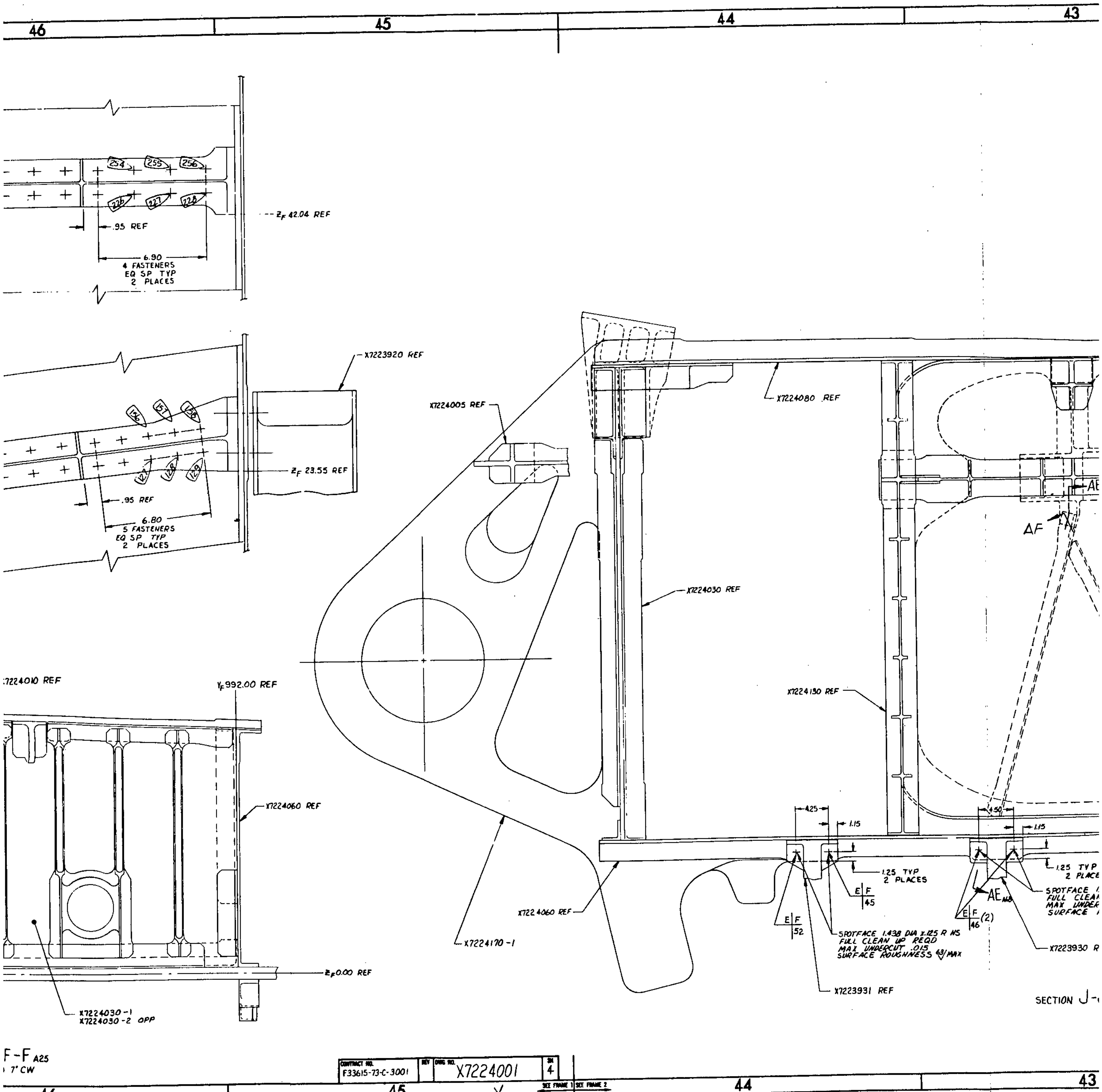


3

FIGURE 2.2.1-14, SHEET 3 OF 6
FASTENER HOLE IDENTIFICATION - WCTS ASSEMBLY

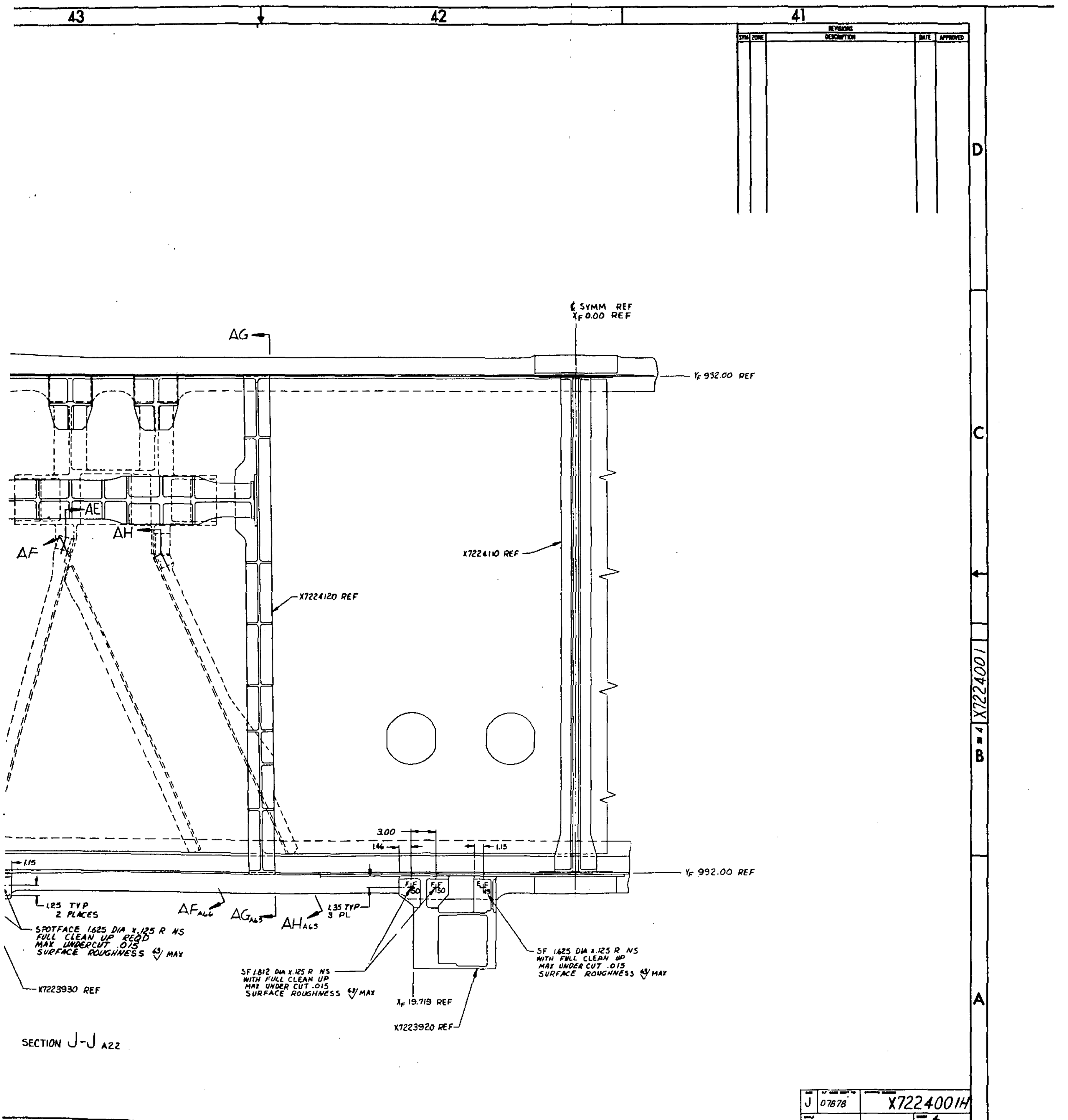


48
47
46
X7224114 REF
X7224110 REF
.75 TYP
.95 REF
.95 TYP
6.90
4 FASTENERS
EQ SP TYP
2 PLACES
5 FASTENERS
EQ SP TYP
8 PLACES
ZF 42.28 REF
.3770
.3750 HOLE (56)
81755/C020-12-18(56) HEAD LCTN OPT
81755/C2950-12(56)
X7223991-12(56) UNDER HEAD
TORQUE PER 81755/M016-6A
SECTION M-M D26
SCALE 1/2
ALL HOLES THIS VIEW
PREFIXED 'G'
ZF 16.99 REF
6.60
4 FASTENERS
EQ SP TYP
2 PLACES
.3770
.3750 HOLE (58)
81755/C020-12-19(58) HEAD LCTN OPT
81755/C2950-12(58)
X7223991-12(58) UNDER HEAD
TORQUE PER 81755/M016-6A
SECTION N-N D24
SCALE 1/2
ALL HOLES THIS VIEW
PREFIXED 'G'
YF 932.00 REF
X7224010 REF
X7224080 REF
X7224170 REF
SECTION F-F A25
ROTATED 7° CW
D
C
B
A



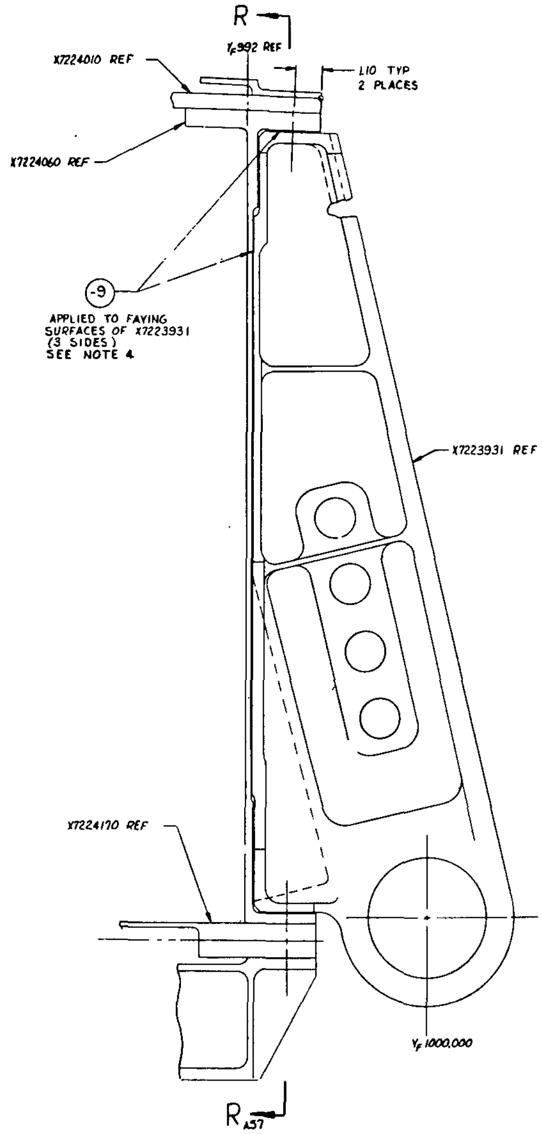
CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001		X7224001	4

2

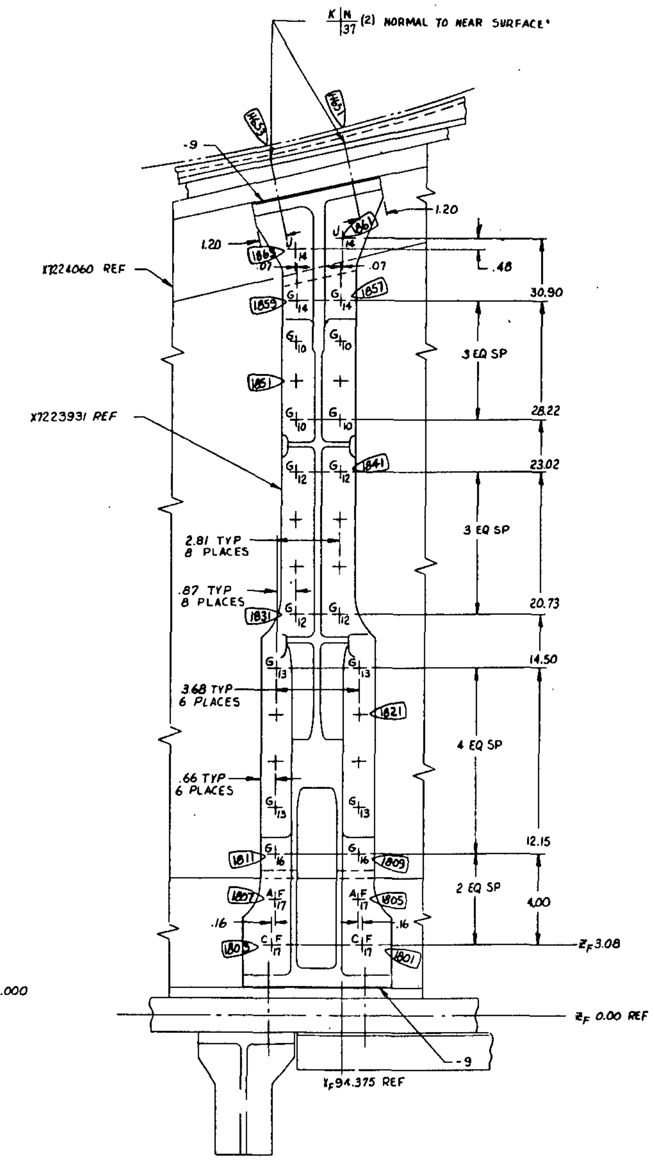


3

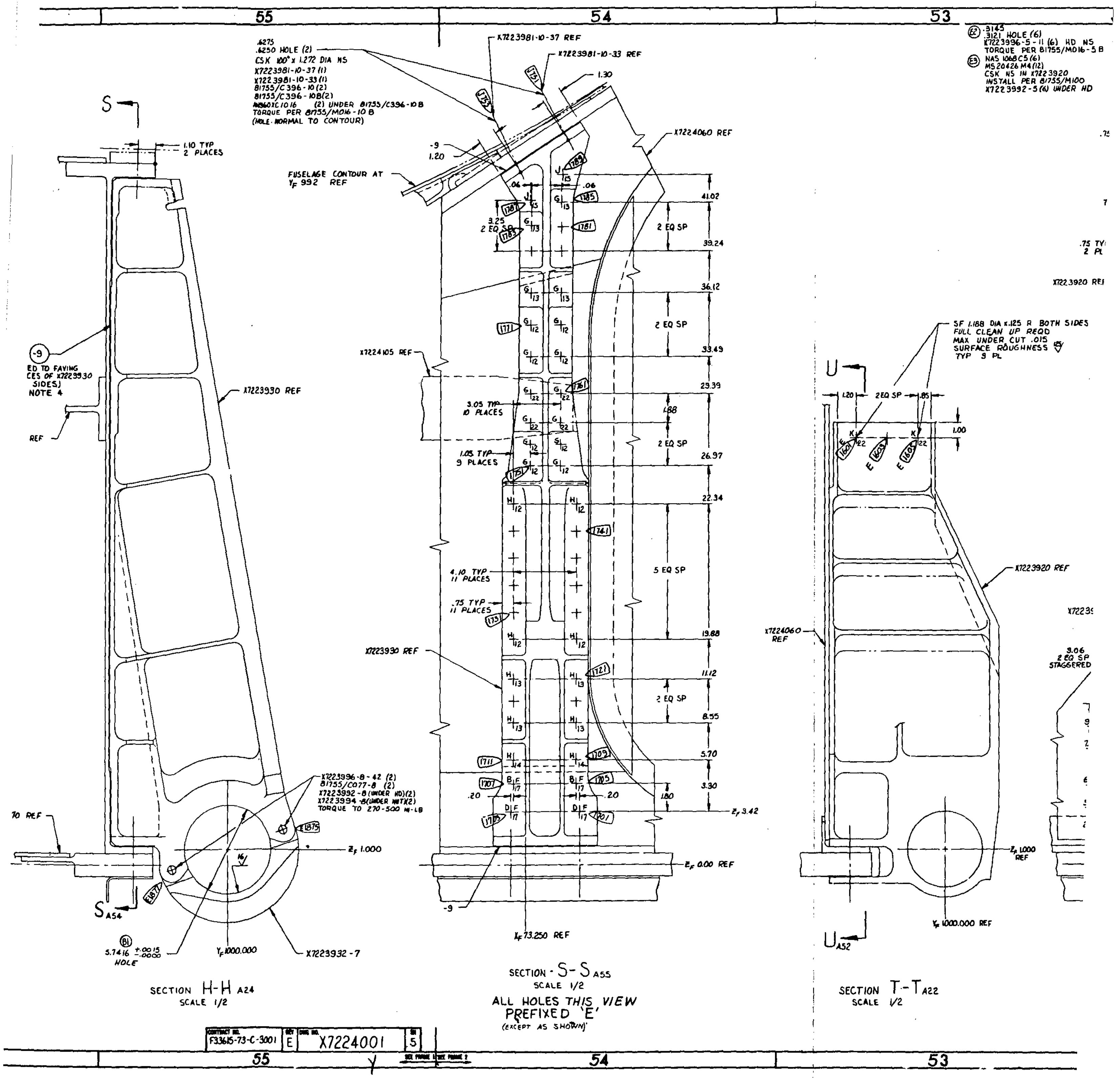
FIGURE 2.2.1-14, SHEET 4 OF 6
FASTENER HOLE IDENTIFICATION - WCTS ASSEMBLY



SECTION G-G A24
SCALE 1/2

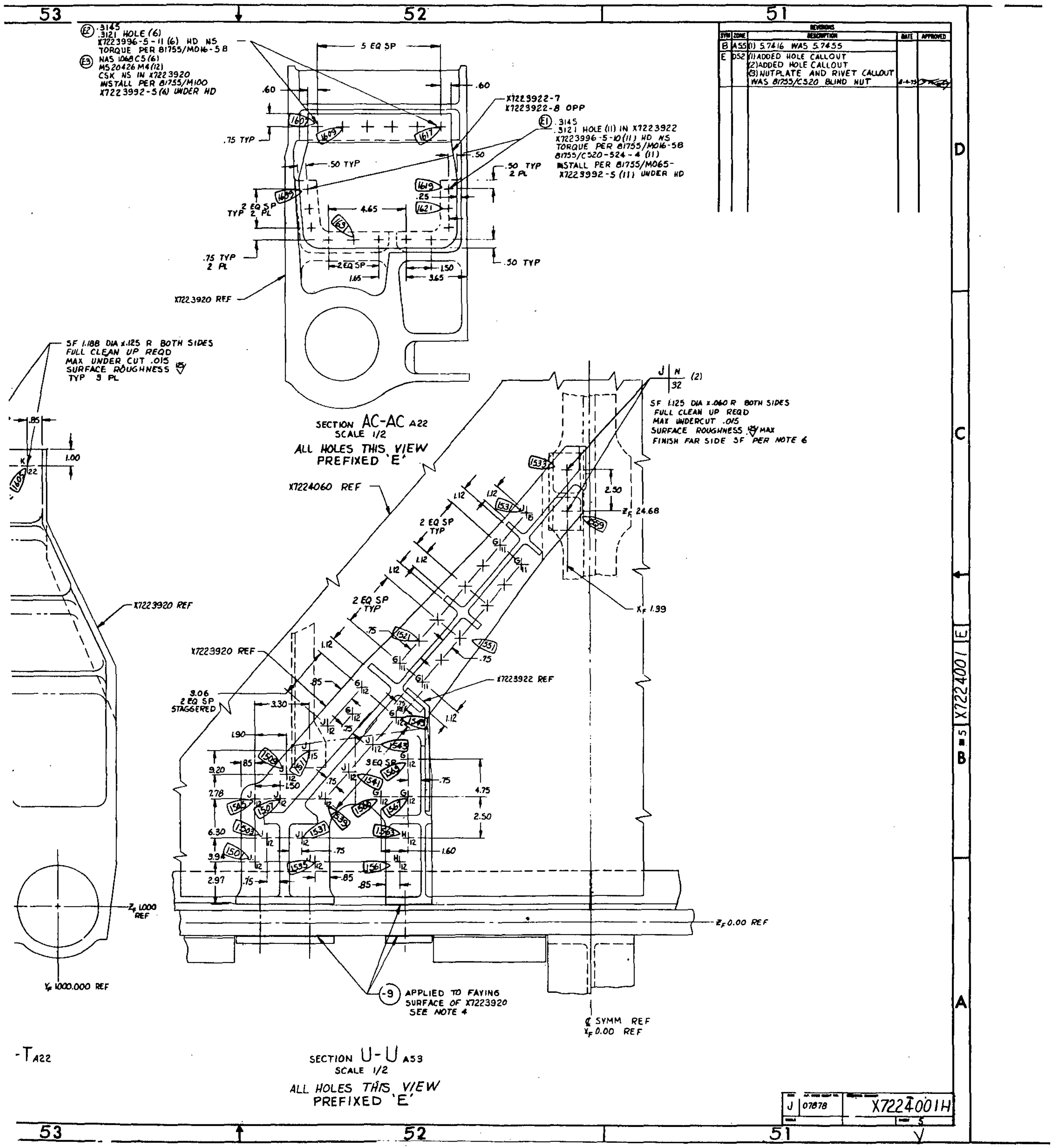


SECTION R-R A58
SCALE 1/2
ALL HOLES THIS VIEW PREFIXED 'E'
(EXCEPT AS SHOWN)



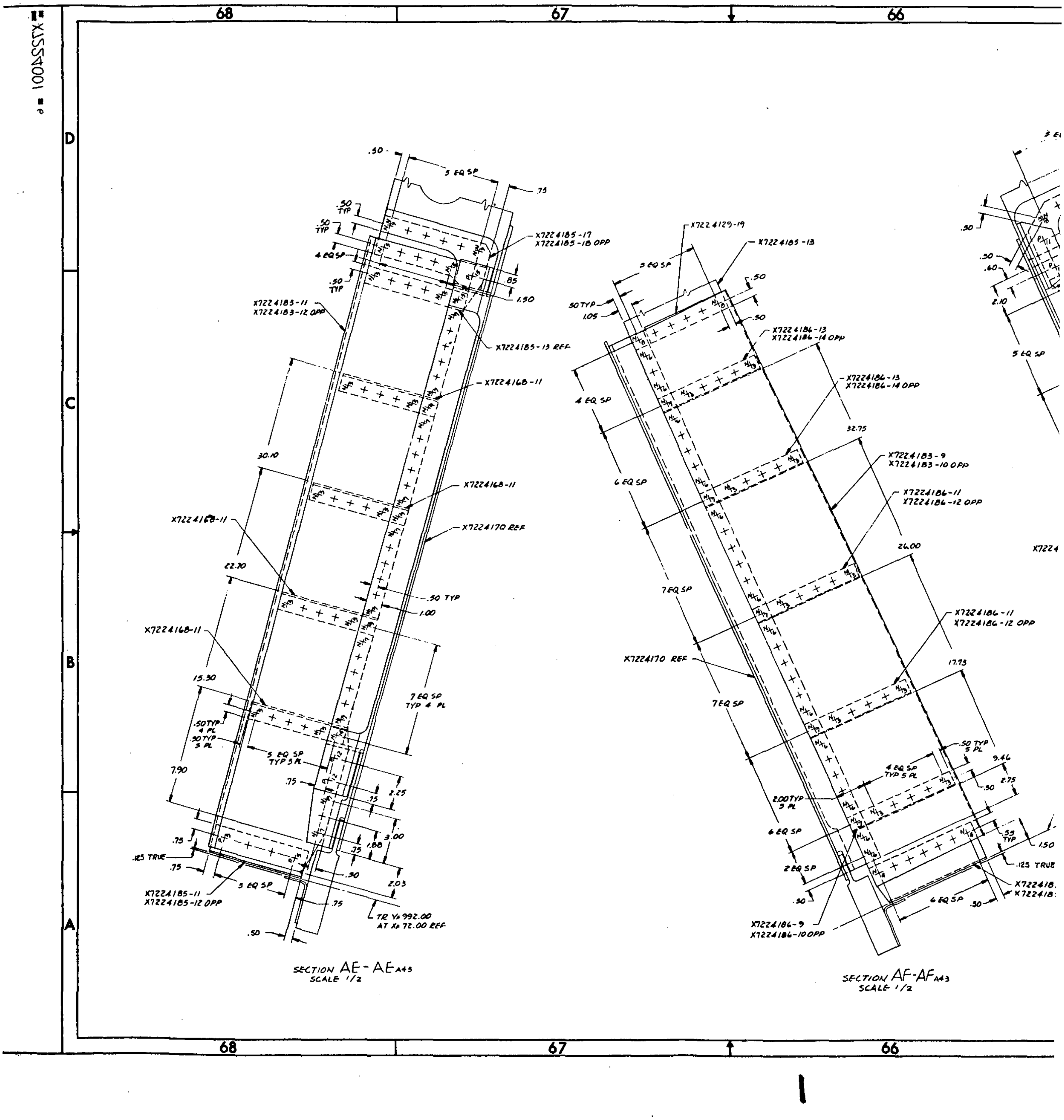
55
54
53
.6275
.6250 HOLE (2)
CSK 100° x 1.272 DIA NS
X7223981-10-37 (1)
X7223981-10-33 (1)
81755/C396-10 (2)
81755/C396-10B (2)
(2) UNDER 81755/C396-10B
TORQUE PER 81755/M016-10 B
(HOLE NORMAL TO CONTOUR)
X7223981-10-37 REF
X7223981-10-33 REF
1.30
X7224060 REF
FUSELAGE CONTOUR AT Y_F 992 REF
1.10 TYP 2 PLACES
X7223930 REF
NOTE 4
REF
70 REF
X7224105 REF
3.05 TYP 10 PLACES
1.05 TYP 9 PLACES
4.10 TYP 11 PLACES
.75 TYP 11 PLACES
X7223930 REF
2 EQ SP
5 EQ SP
41.02
39.24
36.12
33.49
29.39
26.97
22.34
19.88
11.12
8.55
5.70
3.30
Z_F 3.42
Z_F 1.000
Z_F 0.00 REF
X_F 73.250 REF
X7223996-8-42 (2)
81755/C077-8 (2)
X7223992-8 (UNDER HD)(2)
X7223994-8 (UNDER NUT)(2)
TORQUE TO 270-500 IN-LB
5.7416 +.0015 -.0000 HOLE
Y_F 1000.000
X7223932-7
SECTION H-H A24
SCALE 1/2
SECTION - S-S A55
SCALE 1/2
ALL HOLES THIS VIEW PREFIXED 'E'
(EXCEPT AS SHOWN)
.3145
.3121 HOLE (6)
X7223996-5-11 (6) HD NS
TORQUE PER 81755/M016-5 B
NAS 1068C5 (6)
MS20426 M4 (12)
CSK NS IN X7223920
INSTALL PER 81755/M100
X7223992-5 (6) UNDER HD
SF 1.188 DIA x .125 R BOTH SIDES
FULL CLEAN UP REQD
MAX UNDER CUT .015
SURFACE ROUGHNESS
TYP 9 PL
X7223920 REF
X7224060 REF
Z_F 1.000 REF
Y_F 1000.000 REF
3.06 2 EQ SP STAGGERED
SECTION T-T A22
SCALE 1/2
CONTRACT NO. F33615-73-C-3001
E
X7224001
5

2



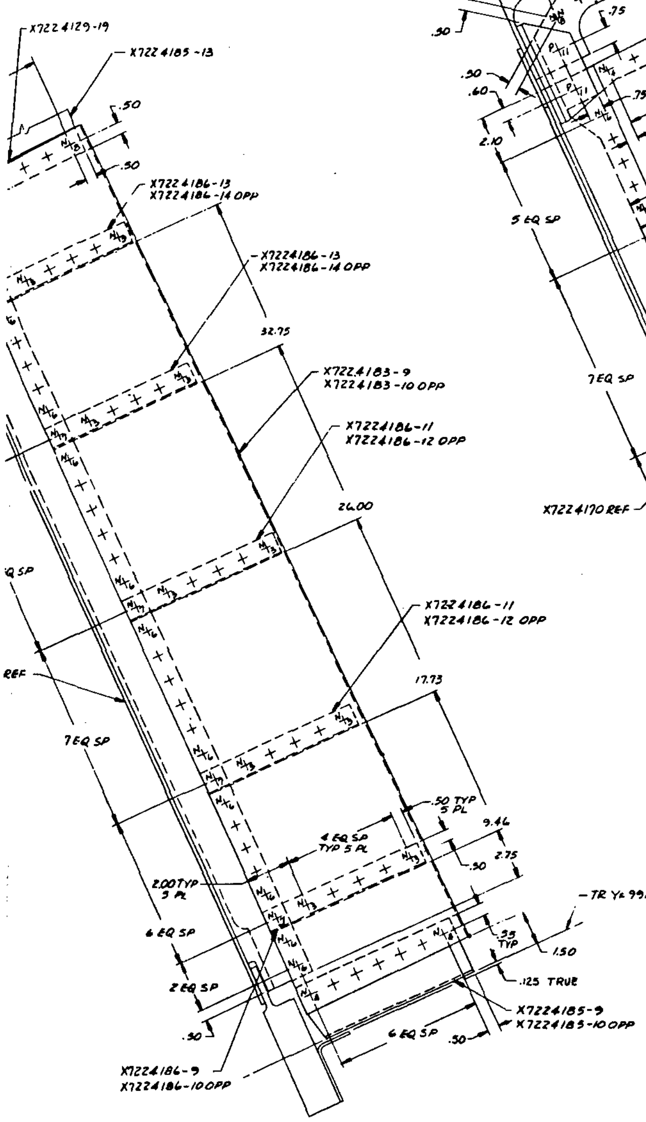
3

FIGURE 2.2.1-14, SHEET 5 OF 6
FASTENER HOLE IDENTIFICATION - WCTS ASSEMBLY

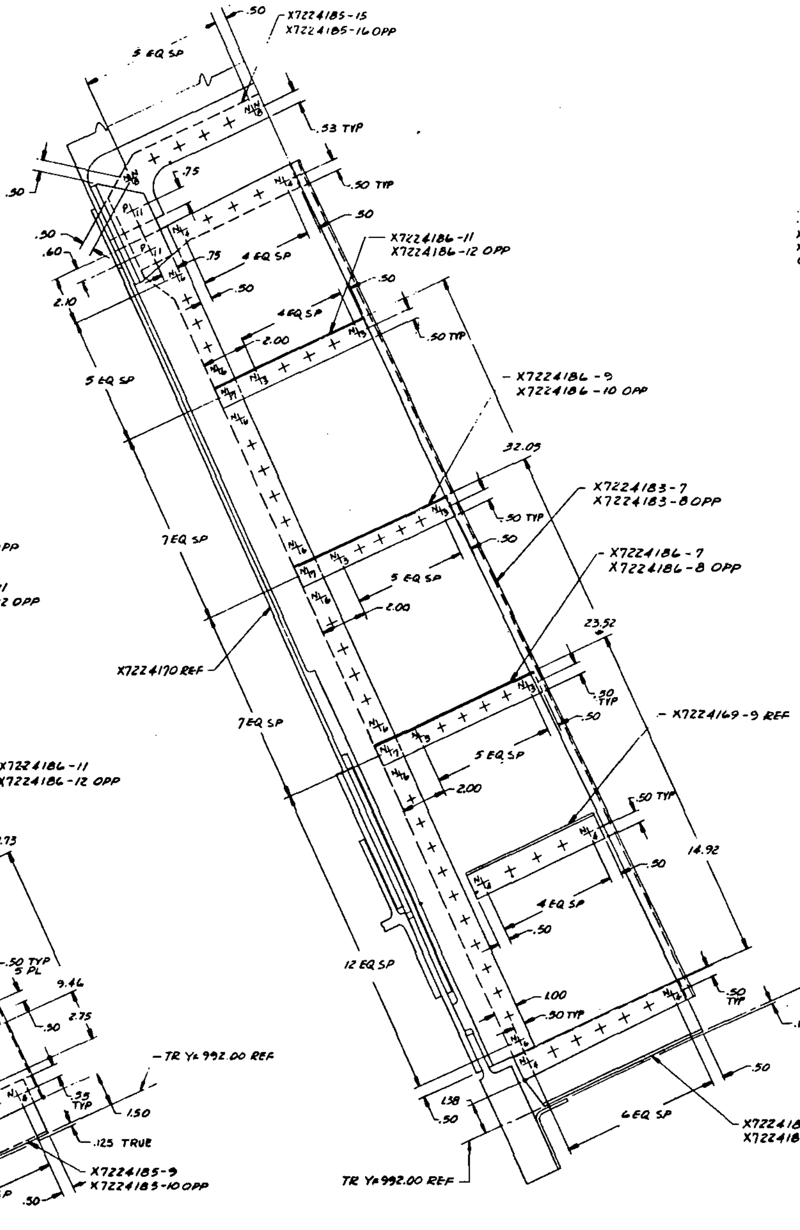


X7224185-17
X7224185-18 OPP
X7224183-11
X7224183-12 OPP
X7224185-13 REF
X7224168-11
X7224170 REF
X7224185-11
X7224185-12 OPP
TR Y=992.00
AT X=72.00 REF
5 EQ SP
4 EQ SP
7 EQ SP
TYP 4 PL
.125 TRUE
SECTION AE-AE A43
SCALE 1/2
X7224129-19
X7224185-13
X7224186-13
X7224186-14 OPP
X7224183-9
X7224183-10 OPP
X7224186-11
X7224186-12 OPP
X7224170 REF
X7224186-9
X7224186-10 OPP
6 EQ SP
2 EQ SP
SECTION AF-AF A43
SCALE 1/2

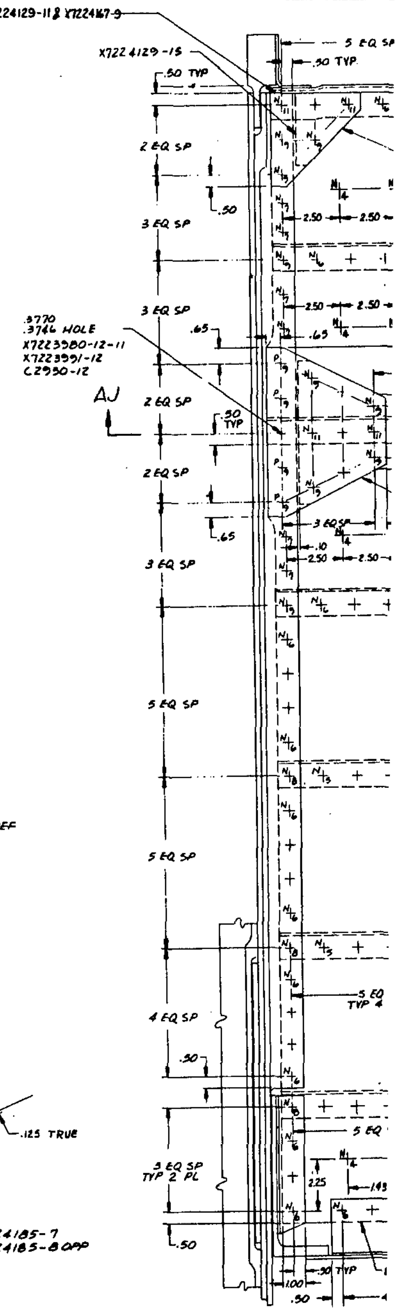
66	65	64



SECTION AF-AF A43
SCALE 1/2



SECTION AH-AH A42
SCALE 1/2



SECTIO[N]
SCA[LE]

CONTRACT NO.	REV	DWG NO.	SH
F33615-73-C-3001	C	X7224001	6

66	65 Y	64

2

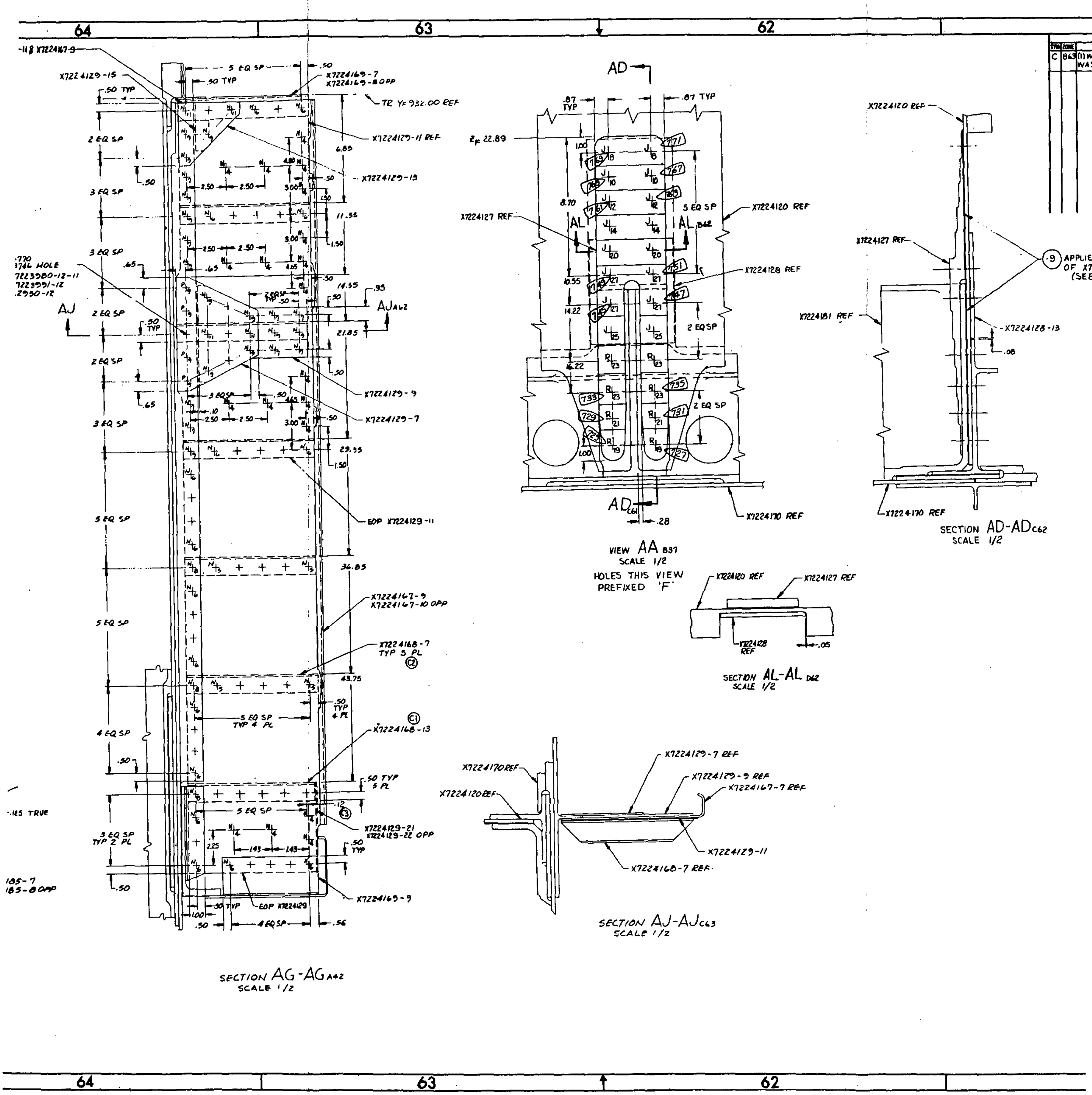


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FIGURE 2.2.1-14, SHEET
FASTENER HOLE IDENTIFICATION -

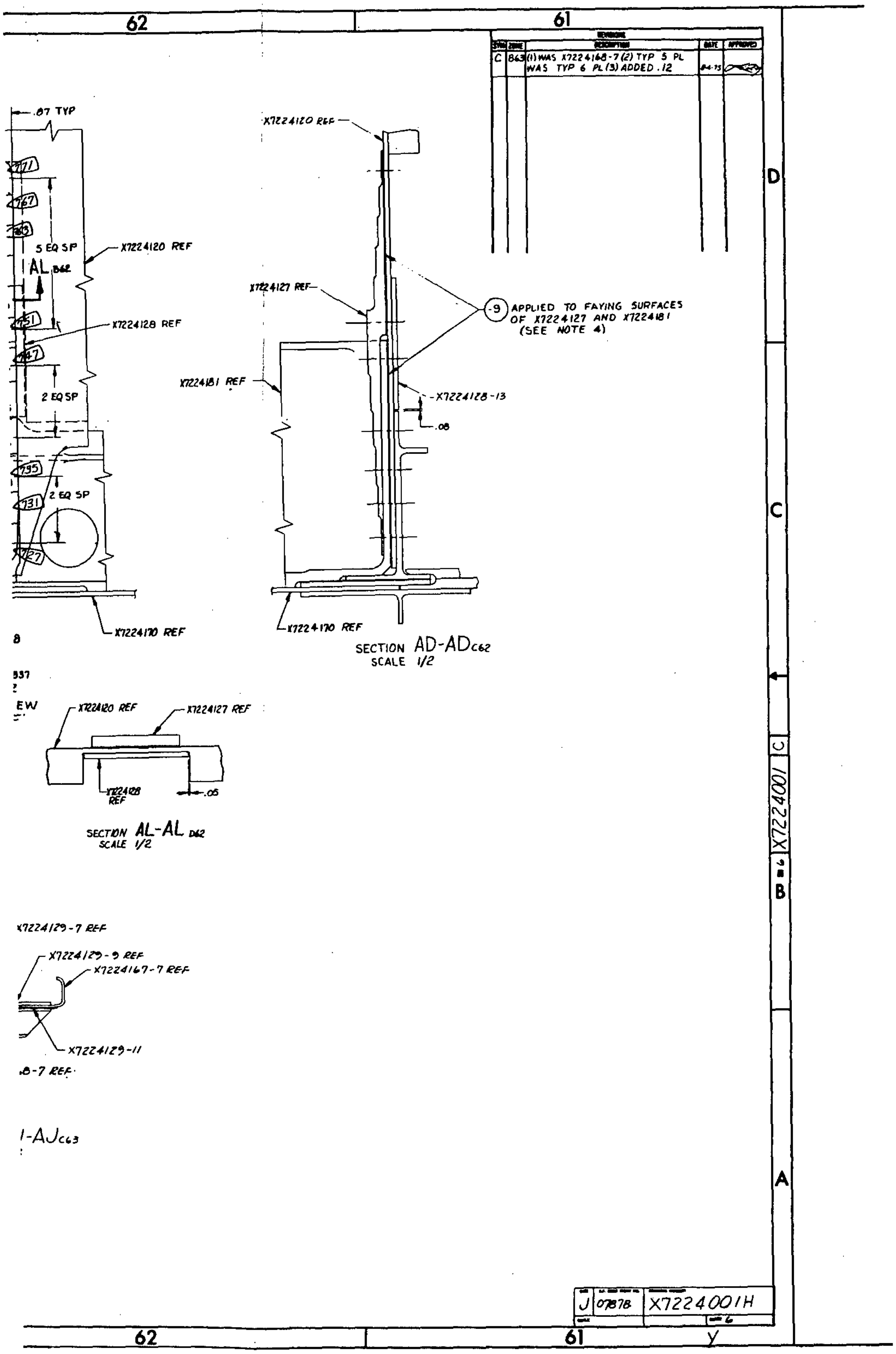

FIGURE 2.2.1-14, SHEET 6 OF 6
FASTENER HOLE IDENTIFICATION - WCTS ASSEMBLY

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SECTION 3

FACTORY PROGRESS

All scheduled factory activities on the WCTS were completed in the prior reporting period.

As described earlier in this report, factory activities during this reporting period consisted of participation on the General Dynamics Teams that accomplished repair and modification tasks at WPAFB.